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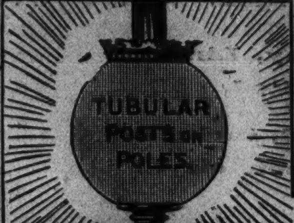
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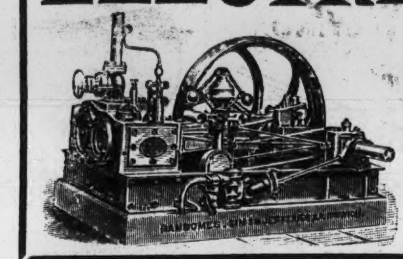

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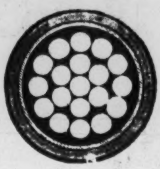

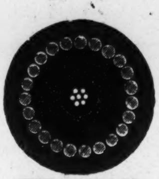

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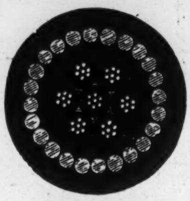

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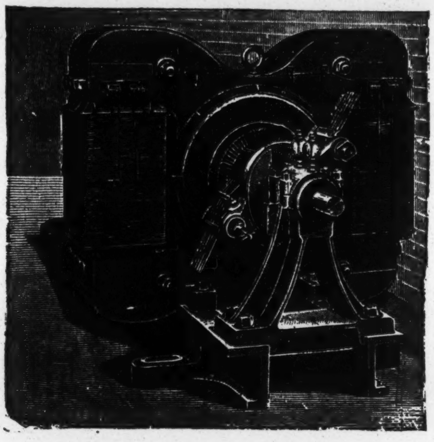

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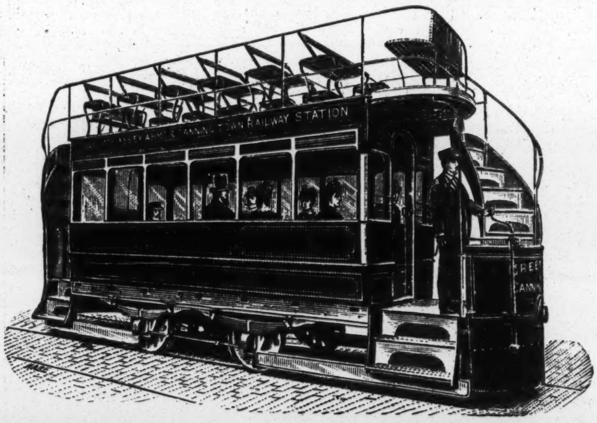

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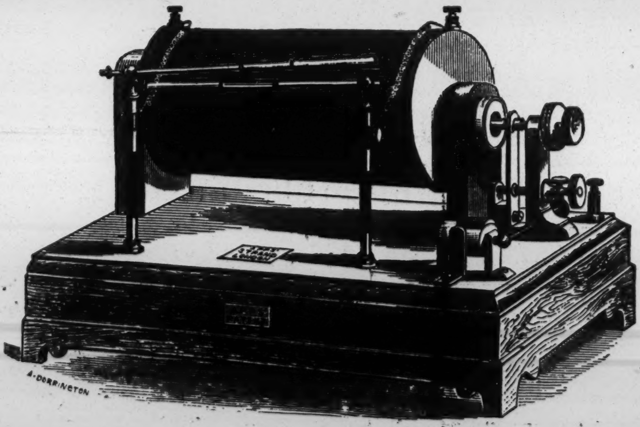

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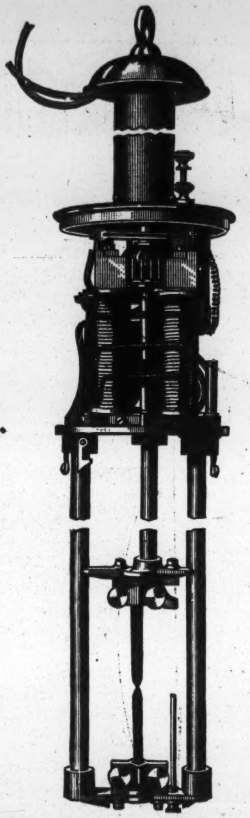

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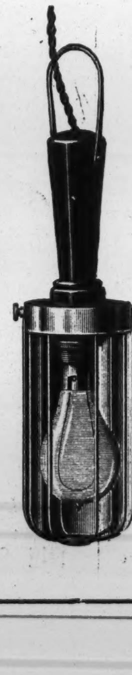

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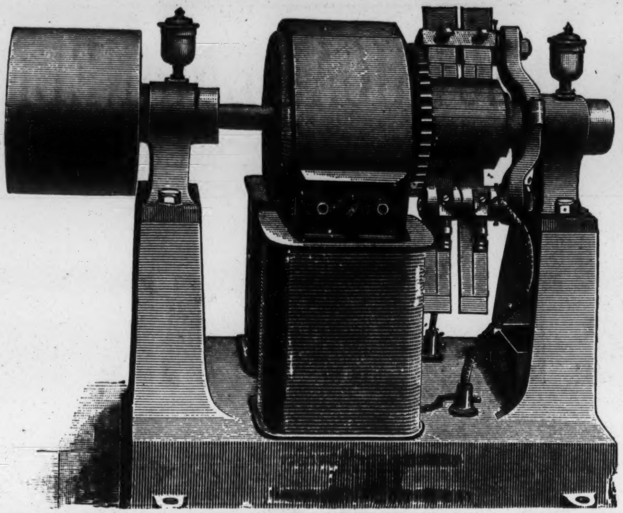

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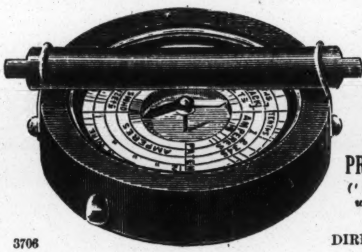

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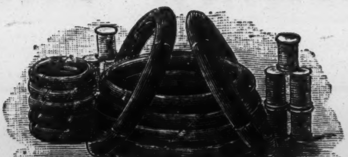

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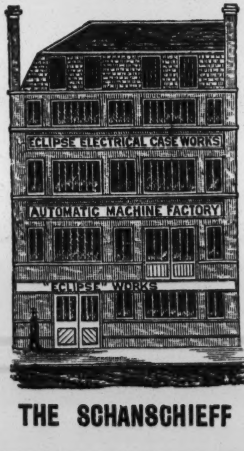

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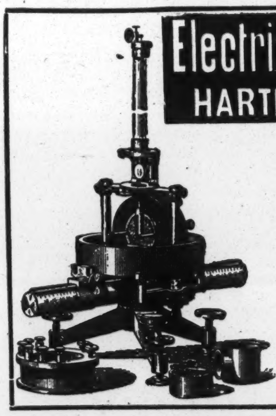

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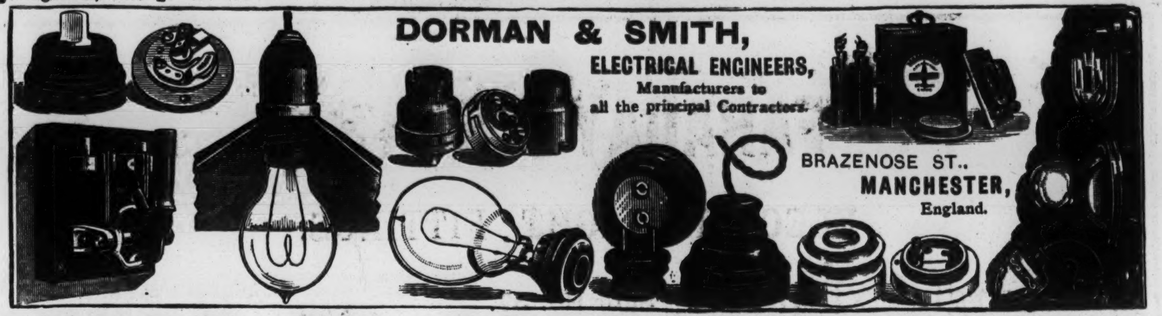

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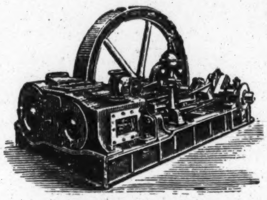

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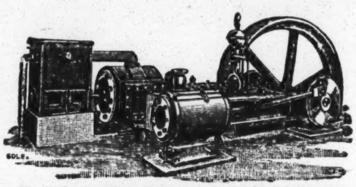

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THE TELEGRAPHIC JOURNAL AND

ELECTRICAL REVIEW.

VOL. XXVII. AUGUST 8, 1890. No. 663.

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PROCEEDINGS OF THE BOARD OF TRADE.

THE Board of Trade has issued a report respecting the applications for orders and proceedings of the Board during the past year. There were 161 applications of which 45 were made by local authorities and 116 by companies or individuals, 23 relating wholly or in part to the County of London. The report states that a modified form of provisional order was made necessary, before the model form settled last year for the metropolis could be made applicable to districts outside the Metropolitan area. In accordance with the Acts all orders granted to companies have been with the full consent of the local authority for the district. When applications have been made by a company and a local authority, the preference in accordance with the rules has been given to the application of the local authority. A clause, however, has been inserted in the orders and licences which enables the local authority, if it thinks fit, to transfer its powers to any given company, with the consent of the Board of Trade; 67 provisional orders have been granted, chiefly to electric light companies, but many have been refused on the ground of not receiving the consent of the local authority; 12 licences have been granted to private persons, companies and local authorities.

A question having arisen as to the interpretation to be placed upon the portion of the Schedule of the Electric Lighting Act, 1882, defining local authorities in Scotland, the Board of Trade consulted the Scotch office, who were of opinion that in certain cases in which authorities in Scotland were authorised to supply gas, they were not the local authority for electric lighting purposes in the capacity in which they supplied gas, and would not be able to utilise the gas rates for electric lighting purposes in the event of their obtaining powers to supply electrical energy.

In the appendix to the report, the regulations are given for the protection of the public safety, also for the protection of the electric lines and works of the Postmaster-General, but these are word for word the same as those published for the first time in the REVIEW for August 30th of last year, and which formed the subject of a leading article in the same issue.

CAPITAL PUNISHMENT BY ELECTRICITY.

UNDER date New York, August 4th, a Dalziel telegram read :—"All America is greatly excited about the fate of the murderer, Kemmler, who, it is now believed, will be executed to-morrow night." Probably all America is now more than satisfied; for after many months of alternate hope and despair, the poor wretch has been done to death. Our readers do not need reminding of the various episodes in this terribly realistic drama, during a period which must have entailed upon the condemned man an amount of mental anguish such as no mortal ever before endured, neither need we dwell upon the combination of circumstances which led to the adoption of electrical execution in New York State as the means of capital punishment. All the incidents which have resulted in the first and, it may be, the last, despatch of criminals by this agency, have been chronicled in our pages.

For several days past the newspapers have published sensational paragraphs concerning the preparations for the prisoner's end. His own bearing at the thoughts of his approaching fate was said to be that of a maniac, the tests of the death machinery were reported in terms of the most absurd nature, and the manner in which the culprit was to spend his last moments has been discussed to the veriest detail in language calculated to shock the most hardened reveller in the horrible.

These incidents are as nothing, however, compared with the doubtlessly grossly exaggerated and sickening reports of the execution itself; reports which, from their improbable nature, must be taken with a grain of salt until official accounts of the death stroke reach our shores.

Nevertheless, there is enough of truth in these highly coloured statements to send a thrill of horror throughout the world. That a *thrice*-repeated application of the current was necessary before the spirit of the condemned man left its earthly tenement, we do not for one moment believe, and with the numerous cases of accidental deaths from high-tension currents before us, we can scarcely think it credible that a carefully-planned scheme to deliberately kill should entail a lengthened period of suffering, when a chance contact has so often resulted in what has, to all intents and purposes, been instantaneous death; indeed, we have hitherto tried our best to prevent fatalities from electricity, and yet many lives have been unwittingly sacrificed. Still, so far as can be gathered from the reporters, it would appear that both in preliminary trials and at the final scene the machinery did not come up to expectation, and so far as it is possible to judge from the garbled versions given by the newspapers, we imagine that the engine was insufficient for its purpose. However this may be, we have to acknowledge the fact that although Kemmler is no more, his execution has been at once a bungle technically, and socially and politically a mistake.

However much we may wish to believe that New York, from humane desires, made electric execution the legal method of expiating one's crimes, there is only too much reason to fear that it was introduced and promoted until it became law by those who had political and personal motives to serve; humanity was ostensibly the plea, but the real reason is less fathomable, although perhaps not altogether beyond one's depth.

Even in the telegrams from America, on the day of execution, it is easy to perceive these conflicting interests at work, and, if we are not mistaken, a certain section of the electrical industry is more or less involved.

As we have previously remarked, it is useless to comment upon the use or abuse of the electrical machinery until authentic details of its performance come to hand, but at the same time we feel that some sort of protest should be brought against the indiscriminate statements which have been scattered broadcast throughout the land. If, as one of the electricians who was present says, "everyone in the room lost his head," how much weight are we to attach to the ghastly descriptions of Kemmler's contortions and apparently agonising sufferings? For our own part, we do not give credence to the statements that the first application of the current was ineffective, although, as the reports of those who were present are so conflicting, we shall probably never learn the exact truth of the matter.

Without expressing any sympathy with the murderer, who seems to have been of that type of man for whom no fate is too bad, it would seem that, as he had for more than a year been the subject for bandying scientific and legal argument throughout the different courts as to whether death by electricity was or was not "cruel, unusual, and unconstitutional," it would have met the ends of justice if he had been kept to penal servitude for life. Whether the effect upon the American populace will be of a demoralising nature remains to be seen. The *Standard* thinks so, and that it can hardly be over-estimated. On the other hand, if the new law stands, it may have a deterrent influence on crime, and, if this turns out to be the case, the first electrical execution may not have been carried out quite without some compensating benefit for the horrors which were attendant upon its enactment. But it cannot be denied that the whole affair partook too much of the nature of a show, and the conversation reported to have arisen between doctors, warder and criminal would seem laughable were it not that the fate of a human being was the subject of the melo-dramatic episode. Indeed, one can scarcely get rid of the feeling that in some respects we are simply reading a criticism of an execution scene in a new and thrilling stage play. The utter lack of solemnity throughout the whole of the proceedings, the numerous assemblage permitted to participate in the tragedy, and the clumsiness with which the fatal stroke seems to have been administered, all combine to make one ask whether all this theatrical display can really have been an incident of to-day. That such was the case is only too true, but let us, for humanity's sake, hope that a like scene will never again figure in the theatre of life.

In the REVIEW for June 4th, 1889, we carefully considered, from various standpoints, the question of execution by electricity, and notwithstanding the impression which the bungling over Kemmler must have produced in the public mind, we do not think there is any need to modify anything we then said. We confessed that at first we were reluctant to entertain the idea of electrical means being adopted for the purpose. But this was mere sentimentality—selfish sentimentality; and when we came to reason calmly, we could not perceive that we had more cause to object or complain than would the hydraulic engineer if death by drowning were proposed, or the cutlers of Sheffield, if the guillotine were to be brought into use in this country. The trend of civilisation, moreover, being towards lessening rather than increasing the horrors of capital punishment, it behoved us to consider whether death by electricity could not be made immediate and sure, for the rope has not been infallible. We thought so, and again we assert our belief that in proper hands there need be no hitch and no fear of failure with the electric current.

The *Standard* on Electrical Executions.

YESTERDAY'S leading article in the *Standard* concludes as follows:—"The demoralising effect which such a scandalous scene as that enacted yesterday must have upon a large portion of the population of New York, and, indeed, of the United States, can hardly be over-estimated. The publication of minute accounts of every detail of what took place made the thrice-repeated efforts to stamp the life out of Kemmler visible to the whole nation, and fed the desire for sensationalism already too largely pandered to in the New World. The American public was yesterday thrilling with anxiety, not to hear that a brutal murderer had paid the penalty of his crimes, but to learn how long, and with what particular circumstances of horror, an alternating current is in destroying a human being.

The criminality of the man to be executed was not thought of. Kemmler was simply looked upon as a subject who might fairly be used for the great experiment. That the existence of this unwholesome and degrading sentiment shows any special depravity on the part of the New Yorkers we do not desire to assert for a moment. Electricity for the last few years has been the toy of the American people, and they have employed it for every conceivable purpose. At last some ingenious mechanist suggested that it should be used to get rid of criminals. The idea seems at once to have captivated the minds of the State Assembly, and they proceeded to adopt the suggestion. No doubt they soon grew persuaded that they were acting in the interests of humanity, though, in truth, they were lending themselves to a popular craze, and were merely endeavouring to show that there was no end to the wonders of electricity. Such levity, had it been conscious, could only have been described as inhuman; as it is, we must condemn the lack of judgment which prevented the members of the two Houses realising that they were prostituting the sacred work of legislation to the vilest sensationalism. Had the infliction of the death sentence by hanging outraged public opinion by constant failures, and had it thus become necessary to devise some new method, it might have been possible to find an excuse for the action of the Legislature. No such considerations, however, existed to influence them. The law, as already remarked, was simply and solely the outcome of an electrical craze. When this was the origin of the Act, it could have no other effect but that of demoralising the whole tone of the community in regard to capital punishment. Even had the process worked well instead of badly, it must have tended to make people look upon executions as sensational exhibitions of the powers of modern science. As it is, it is impossible to be sure that torture of the most excruciating kind has not been added to the death penalty in New York. But will popular feeling in the States allow the recent alterations in the law to stand? We doubt it. The Americans are, we believe, not less humane than their kinsfolk on this side of the Atlantic, and the sickening spectacle of yesterday will kindle a feeling of horror and disgust which neither Congressmen nor Senators will be able to disregard."

Electric *v.* Steam Traction for Elevated Railways.

THE *Financial News* published an article on the 25th ult., entitled "Electricity as a motive power." It was mainly based upon the experiments of Mr. Moss, of the Manhattan elevated railway of New York, and the results to the casual observer are calculated to lead him to the belief that electric traction is a fraud. It seems, however, that Mr. Moss must have got hold of some electrical plant belonging to a prehistoric age, as may be gathered from the following :—"Leaving Thirtieth Street, for instance, up a gradient of about 1 in 60, the horse-power exerted by the driving engine indicated 395, while at the same time but 7·6 horse-power, as indicated by a dynamometer, was being exerted to pull the train, showing less than 2 per cent. of the power of the engine transmitted to the train at that instant." We would like to know what kind of conductors were used for conveying the current and the state of their insulation, but on these points we find nothing. The *Financial News* is not improving the chances of commercial men taking to electric traction by quoting figures which give one side of the matter only, but perhaps the policy of that journal lies in an opposite direction; in any case another paper, the *Railroad Gazette*, shows, from Mr. Moss's own figures, that propulsion by electricity, instead of being four times as expensive as steam traction for the elevated railway, shows a decided economy.

"Death by the Visitation of God."

THUS runs the verdict of the jury which last Saturday met to consider the death of Private Sanford, who while watching a cricket match was killed by lightning, at the same time several companions also were severely injured. To say the least it is surprising that a body of men under the guidance of a coroner, who we presume to be an educated man, should return so anomalous a verdict. To appreciate a verdict of that character we must go back to the days when the ducking stool and the moot hall were time honoured institutions. Doubtless there would be many peculiar verdicts when the supernatural and mysterious influenced the mind, but one would have thought that we, in the 19th century, knew a little better. As showing the logical conclusions of the jury, the conduct of a Doctor Trask, who restored animation in the injured men, was highly praised, and owing to his exertions one man who would have died was restored. We are afraid that the worthy doctor must have defeated the ends of Providence by his timely act.

What Constitutes an Invention.

THE following extracts are from the opinions of three of the best American judges, and will probably suffice to define what constitutes a patentable invention, which is interesting to everybody :—

> An invention, in the sense of the patent law, means the finding out, the contriving, the creating, of something which did not exist and was not known before, and which can be made useful and advantageous in the pursuits of life, or which can add to the enjoyment of mankind. In other words, the thing patented must be new; and it must be useful to an appreciable extent, though the measure of that usefulness is not material. Any degree of utility appreciable by a jury is sufficient, upon the question of utility, to sustain a patent. . . . . . Invention is the work of the brain, and not of the hand. If the conception is practically complete, the artizan who gives it reflex and embodiment in a machine is no more the inventor than the tools with which he works. Both are instruments in the hands of him who sets them in motion and prescribes the work to be done. Mere mechanical skill can never rise to the sphere of invention. The latter involves higher thought, and brings into activity a higher faculty. Their domains are distinct. The line which separates them is sometimes difficult to trace; nevertheless, in the eye of the law, it subsists. The mechanic may greatly aid the inventor, but cannot usurp his place. . . . . . The simplicity of an invention, so far as being an objection to it, may constitute its great excellence and value. Indeed, to produce a great result by very simple means, before unknown or unthought of, is not unfrequently the peculiar characteristic of the very highest class of minds. A subject matter to be patentable must require invention; but it is not necessarily the result of long and painful study, or embodied alone in complex mechanism. A single flash of thought may reveal to the mind of the inventor the new idea, and a frail and simple contrivance may embody it. Some inventions are the result of long and weary years of study and labour, pursued in the face of abortive experiments, baffled attempts, and finally reached after the severest struggles; while others are the fruit of a single happy thought.

THE EDISON PHONOGRAPHIC TOY.

(A BANK HOLIDAY RHAPSODY.)

FROM the giant mind of the mighty Edison has sprung the crowning boon and blessing to men and infants. Monday last week saw the lists open for subscriptions to the Edison Phonographic Toy and Automaton Company, Limited, and Wednesday witnessed their close. In that time, if all went well, £300,000 of capital was paid in to Messrs. Brown, Jansen & Co., to the credit of the undertaking, of which £270,000 is to benefit the vendors and £30,000 the shareholders—perhaps? A military baronet holds the chair, with another soldier and three civilians as colleagues on the board, and there are five several firms of brokers to the company. Brokers live on commissions; commissions depend on transactions in shares, so it looks as if these were expected.

If you want to bore a man or boy try to instruct him; if you want his love, although temporarily, it may be, amuse him. For years we have done our best to instruct the public, and, accordingly, have not amassed a fortune. Oh! that we had earlier perceived the right path, become speaking dolls and sold ourselves for £270,000, less commission to brokers.

Perhaps the promoters would have done wisely to have rested their hopes ostensibly on the doll business, and not have referred in the prospectus to the utilitarian possibilities of the invention, unless they had proceeded further, and touched upon the more important uses which must infallibly follow. We are to have "talking automata in bar rooms, restaurants, cigar shops, and show-rooms of all kinds, to call the attention of customers to particular articles." Why stop at this dull, prosaic view, when the vista into which even our dull mental vision can penetrate is so glorious? With what rapture must the Wizard of Menlo Park have peered into the future of the talking doll after a few years of development. We can only suppose that his well-known modesty kept him from putting it all in the prospectus, or else the directors cut it out to save expense in printing and postage.

The uses enumerated in the above quotation seem ill-chosen. Surely Messrs. Spiers and Pond understand human nature better than to supplant their pleasant young ladies by talking automata? There is a sympathetic electric current induced in sexes of opposite signs by nature herself, and the most modish robes and a three guinea head of real hair handing over the glass of bitter, and saying "tuppence please, thank you," would fall stale, flat, and unprofitable upon the ear of the dude. Again, "What is the next article?" is irritating enough to the average male, but spoken by an automaton, possibly with an American twang, would raise his evil passions to such a pitch, that the said figure would be in a parlous state, if not actually demolished by the umbrella of the irate one; in which case no enlightened jury would return a verdict other than justifiable dollicide.

But think of that poor man who, having lost his wife, never slept again because he missed the curtain lecture. Had he but possessed a phonographic image, into the "body" of which (price 12s.) the dear departed had once spoken the words of admonition, he could have laid it reverently on the pillow by his side, and let it off nightly at the appointed hour. The same old tale reiterated each bedtime would have been monotonous enough to send the most hardened insomniac soundly to sleep.

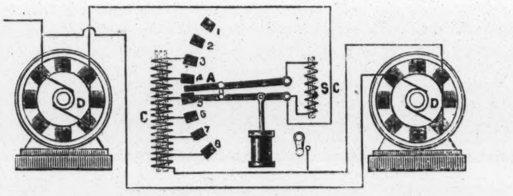
Not only will advertising media, but religion be extended. The poor district which cannot afford an incumbent could go to "between £3 and £4" for a phonographic automatic parson. The lights of the Abbey and St. Paul's, of the Tabernacle and the Temple, can have an illimitable sphere of action, and let us hope a handsome honorarium, at per annum or per hour, for preaching all day and every day at phonographic bodies, which can be despatched by parcels post through the length and breadth of the land, ensuring eloquence and sound doctrine, and setting free to take their place in the battle of commercial life, alike the high church curate and the young baptist minister, to the detriment of tennis, no doubt, but to the good of the community.

Fancy an age of phonographic *prima donnas* in every village schoolroom, and the more than ever automaton chairman reeling out well-considered speeches at annual meetings. Or say, Mr. Gladstone is indisposed in consequence of an adverse vote, would his verbosity be diminished? Not at all. Up stands his *alter ego*, and the exuberent phrases flow. An Irish member is sick; his double takes his place with the extra advantage that no calls to order would have any effect; no Speaker could stop him unless the bauble were for once made useful to literally knock his arguments to pieces.

That we do not spin this article out into many volumes is simply that our space is limited. It is a misfortune that scientific commercial companies always choose the days between the issuing of the technical papers for the bringing forward of their prospectuses, and we are debarred from helping them by our praises in time to aid their subscriptions. All we can utter is: "Too late, too late; you cannot enter now."

METHOD OF SYNCHRONISING ALTERNATE CURRENT MACHINES.*

IT has been the common practice to make the multiple connection of alternating current generators or motors after the impulses are observed to synchronise, various devices being used for determining the times of synchronism. In the method, which is the invention of E. W. Rice, jun., of Lynn, Mass., two or more alternate current dynamos or motors which are developing or running on circuits of approximately the same potential difference, may be coupled in multiple at any time without any special preliminary observation. In a few words, the invention consists in bringing the two machines to synchronism by interposing a reactive coil in the armature circuit between the machines to be connected. In order that the operation of the method may be the more easily understood, it may be explained that the electrical activity displayed in this reactive coil depends upon the amount of current flowing through it. This amount in turn depends upon the difference in the phases of the currents passing to the coil. The effect of this action is to retard or accelerate one or the other of the machines until the phases of the impulses coalesce, because this is the condition of least resistance in the combined circuits. Referring to the diagram which illustrates the method, D is an alternating current dynamo, and D′ is another and similar dynamo or motor. These are connected, as shown, with a variable reactive coil, C.



METHOD OF SYNCHRONISING ALTERNATE CURRENT MACHINES.

Switch arms, A, are insulated, one from the other, but are connected through a smaller reactive coil, S, C. These arms can be moved over the numbered contact plates. Assuming that the dynamo, D, is running, and it is desired to divide its work with the machine, D′, or in case it is desired to throw on the machine, D′, as a motor, the method of procedure is as follows:—The arms, A, which, when the machine, D′, is idle, are supposed to be resting on the contact pieces, 1 and 2—that is, open circuited—are moved, so that the lower arm connects with the contact piece, 3. In this position the working circuit of the machine, D′, is closed with the circuit from the machine, D, through the reactive coil, C. This coil, with the lower arm in the position just mentioned, has all its wire in circuit, and is therefore developing its maximum counter electromotive force. Now, by moving the levers from contacts to contacts, a current from one machine or the other is permitted to act gradually so as to accelerate or retard the machines and bring the alternations into perfect synchronism before connection is made through the ordinary conductor of practically no resistance or reaction. If it is desired that one machine shall take a larger portion of the load than the other, the reactive coil, C, may be left in the circuit connecting the second machine. The function of the smaller reactive coil is to prevent sudden fluctuations of the current when the arms are moved over the contacts.

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* *Western Electrician.*

THE INTERNATIONAL EXHIBITION OF MINING AND METALLURGY.

LAST year a suggestion was brought forward that an exhibition should be held in London this summer for the purpose of demonstrating the great advances which have of late years taken place in mining and metallurgical practice. The idea, which was favourably received in different quarters, has culminated in the present exhibition which was opened at the Crystal Palace, on Monday last week, by Lord Thurlow. The exhibits are distributed throughout the galleries and the palace building, whilst the machinery in motion is erected in a special building built at the north end of the palace. Most of the Colonial Governments are officially represented, that of New South Wales, which occupies the south nave and a large portion of the galleries, having the largest and most interesting collection of different minerals. Many English and foreign mining companies show a number of mining and metallurgical exhibits.

It was expected that several important electrical firms would be *en evidence*, but only a few are represented. The Planet Electrical Engineering Company has a small installation for lighting the machinery hall. The plant comprises a Crompton continuous current dynamo, driven by belting from a Rigg rotary engine. The machinery hall is lighted by 20 Planet arc lamps of 6 ampères, the lamps being arranged two in parallel. Mr. Lars Bristöl shows several of his miners' lamps having accumulator cells. The main feature of these is the fact that the glow lamp is covered by an external thick glass dome which, if accidentally broken, throws the lamp off its holder and interrupts the circuit. It is claimed that by this means the possbility of any explosive gases being ignited is entirely removed. Messrs. J. Davis & Son, of All Saints' Works, Derby, exhibit, among other articles, protector fittings for incandescent lamps, ceiling roses, ammeters, voltmeters, switches, electric blasting apparatus, &c. Various electric firing batteries, galvanometers, electric wires and electric mining appliances are to be found on the stand of the Cotton Powder Company, Limited, and similar apparatus are also on view by Nobel's Explosives Company, Limited. Messrs. Woodhouse and Rawson United, Limited, have an interesting collection of electric bells, batteries, lamps, &c.

Of engineering firms, Messrs. Davey, Paxman & Co. have the largest display. They show, among others, a 40 H.P. horizontal engine and two horizontal boilers of 40 H.P. This engine drives a line of countershafting from which the machinery in motion is mainly operated. There are also on view an 8 H.P. compound portable engine, an 8 H.P. single cylinder portable engine, a 6 H.P. girder engine, an "Essex" boiler, &c. Messrs. Dick, Kerr and Co. exhibit a Griffin gas engine. The only glass case in the Machinery Hall contains a display of some useful goods manufactured by Messrs. W. H. Willcox & Co., including their special make of wire-bound hose, such as is used for the delivery of petroleum from ships and by the Fire Brigade. Leather belting is shown in various forms, as well as a number of other articles in daily use in mining operations.

The exhibition will remain open until the middle of October.

SOME DEFECTS IN PHYSICAL TERMINOLOGY.

By PROF. A. E. DOLBEAR.

WE abstract the following from the New York *Electrical Engineer*:—In the subject of electricity the lack of definitions in the terminology has led to a great deal of confused thought, but our actual knowledge of the character of electricity is much greater than many suppose it to be. Maxwell and others have asserted that whatever it may be it is not energy, while others, as represented by Preece in his late presidential address, assert that it is energy. Curiously enough Maxwell declares that it cannot be energy because electric energy is a *product* of electricity, E, into a current, C.

Edlund and some others have thought electricity to be identical with the ether, while still others have imagined it to be a fluid, or two fluids, or some kind of matter with the fundamental property of matter—namely, *mass*, left out. It is not very difficult now to see how such varied conceptions arose. An electrified body affects the space about it, or, as we now say, it produces an electric field which is known to be a stress in the ether, and that implies a strain in the electrified body. It is also known that such stress is propagated in the ether with the common speed of ether waves—namely, 186,300 miles per second. The speed of this movement has been measured by so many, and in so many ways, that there is no doubt about it, and since the experiments of Hertz there is no room for doubt as to the existence of the ether.

What we now know is that states of stress in the ether are propagated at a definite rate in it, which rate depends not upon the source of the movement but upon the property of the ether to transmit movement; so, whether heat movements or electrical movements are antecedent makes no difference. We find no difference in perceiving the relation between the vibratory molecular motions and the resulting waves in the ether, but here is a precisely analogous case of electrified molecules and the ether propagating a motion, which implies, if anything, that molecular motion is the source of the ether displacements. One person will give chief attention to what is going on in the electrified matter, and another person to what is going on in the ether, and they come to different conclusions as to the nature of electricity, while a third person who notes their discrepant notions concludes that no one knows anything about it. What we call electricity originates in matter, and there is no evidence whatever that it ever originates apart from it. As Rowland has somewhere said: "It begins in matter and ends in matter." The conditions for its origination are differing and interfering molecular motions, whether in a thermopile, a galvanic battery or a dynamo; the conditions for its transference are a continuous material conductor, for it cannot traverse a vacuum. The effect upon the ether we call an inductive effect; and just as in heat phenomena we have a transference and a transformation, so is there also in electrical, both a transference and a transformation. In heat phenomena, where matter is placed in the *thermal field* so that the ether undulations fall upon it, the matter is heated. Likewise, when matter is placed in an electric field the matter is electrified. The cases are exactly analogous, and one is therefore justified in making the terminology appropriate to the phenomena; and whenever there has been a transformation in the motion, another name ought to be adopted and not let the old one do double duty. If molecular motions of any kind be called electricity, then it is not proper to call any effects in the ether by that name. If the effects we study in the ether be called electricity, then do we need a name for what takes place in matter, for one is the effect of the other.

If one adopts the doctrine of the conservation of energy, and also that the matter of the earth is practically a constant quantity, it will lead him to conclude that all the varieties of energy are due to the various forms of motion that matter may have. If, also, one perceives that motion of any kind, at any place, implies antecedent motion, he will not feel the necessity for looking for hyperphysical explanations for any physical phenomena. For instance, when one sees the light and feels the heat from an electric arc lamp, knowing the nature of both the light and heat as being but particular forms of motion—one in matter, the other in the ether—he could logically look for nothing but some kind of motion that had been transformed to produce such effects. It is entirely immaterial what the character of the motions may be that produce electrical effects—that may remain to be determined by experiment—just as in the case of heat after the work of Sir Humphrey Davy and Count Rumford, it was then settled what the *nature* of heat was—namely, a molecular motion of some sort and not an entity. It is only within a few years that the character of the motion has been determined. In like manner we may say that we know what the *nature* of electricity is—that it is also molecular motion of some sort to be experimentally determined.

There are numerous reasons for thinking it to be a rotation as distinguished from a vibration. One of the chief of these comes from a study of electromagnetic effects in the ether. It is generally agreed that this magnetic effect in the ether is of the nature of a whirl, or rotation, and in numerous treatises these whirls are pictured, but I do not remember to have noted that anyone has pointed out that a whirl in the ether implies a rotation of a molecule, for a simple reason that an undulation in the ether implies a vibration of the molecule. To me this appears to be necessary, but whether the motion be that or some more complex kind does not so much matter—it will be discovered in time.

There is one more important matter I want to allude to, and that is the expression first used by Maxwell, namely, "Light as an electro-magnetic phenomenon." Waiving for the time the criticism that light, being a physiological phenomenon, is therefore entirely inappropriate here, there still remains this fact that the ether waves from heated bodies move in straight lines, and unless deflected by the reflections and refractions of matter, will continue indefinitely on in the same straight line, making the *field of a heated body* as extensive as the universe; while the field of an electrified body depends upon the proximity of masses of matter, and practically is always limited in extent, and the observed lines are always curved. So if the two kinds of waves were really parts of the same movement, what is called a ray of light would seldom or never be found to move in a straight line for any considerable distance. If, on the other hand, the wave that originates in a vibration continues in a straight line only so long as it moves in homogeneous ether, and has its place of vibration changed by passing through a space of ether that has been electrically warped, as we experimentally discover to be the case, it would seem to follow that the two kinds of motion in the ether are fundamentally unlike. Either can exist without the other, and therefore they ought not to be called by the same name.

EDINBURGH EXHIBITION.

(*Continued from page* 126.)

No. 162.—*The Electric Engineering Corporation, Limited.*—This exhibit includes a Statter-Brunton constant current dynamo as supplied for driving the tramways in the Via Flaminia at Rome. This machine is fitted with Statter and Brunton's patent automatic regulator and maintains a constant current of 30 ampères with a maximum E.M.F. of 750 volts at 750 revolutions. The machine is shown at Edinburgh driving three motors in series. These motors are placed on the stand. One of them drives a D.D. compound wound dynamo having an E.M.F. of 60 volts and a maximum current of 75 ampères at 1,300 revolutions. This machine is used to light the stand. Another of the motors is run light. They are fitted with constant current regulators which maintain an absolutely constant speed from full load to no load. A third motor is combined with a hoist and illustrates the adaptability of the constant current system for transmission of power for such purposes. The hoist may be started, stopped and regulated with extreme nicety. The system is fully protected by patent. The exhibit also includes a high speed engine with automatic governor acting directly upon the cut-out. This engine has single cylinders, since the available boiler space at the exhibition is low. An Atkinson 2 H.P. nominal gas engine is shown combined with a D.C. dynamo. This is used to drive arc lights in parallel the lamps employed being the Statter patent arc lamp.

The Corporation also exhibits a 20 inch projector fitted with patent diverging gear. The projector is made in brass and gun metal and complies with Admiralty specification. For the Executive Council it has equipped the electrical tramway running from the Caledonian Station to the Exhibition. Each car is driven by a 15 H.P. motor, the driving power being derived from two 30 unit Statter dynamos.

The telpher line exhibited by this corporation at the exhibition is ¼ mile in length and travels over undulating ground, the highest point being 30 feet from the ground, and the lowest 15 feet. There are two trains, each consisting of a locomotive and four cars. The speed maintained is 5 to 6 miles an hour and the trains are prevented from any possibility of collision by the employment of a dead section in the conductor. The current is derived from the D.M. dynamo exhibited at the stand.

HIGH VERSUS LOW-TENSION.

THE report of the Electricity Committee for the St. Pancras electric lighting, to which we briefly referred in our last issue, is, in several respects, instructive reading, and from the fact that the recommendations contained therein emanate from so high an authority as Dr. Hopkinson, it is of considerable value. But although there is every reason to regard the report as being founded upon a sound basis, it cannot be unreservedly accepted, in the absence of information showing how the recommendations are arrived at. Dr. Hopkinson, in reporting upon the schemes proposed by Prof. Robinson and Mr. Gordon, the one being for a continuous current 200-volt system, using three wires, and the other (that of Mr. Gordon) a 1,000-volt alternating system, states:—"If the distance to which the bulk of the supply is to be transmitted is about one mile, the two systems are about equal in cost; if it exceed a mile the alternating current at 1,000 volts is cheaper than the continuous current at 200 volts, for less distances the continuous current is cheaper." As in the case of St. Pancras, the bulk of the work lies at much less distance than a mile from the station, the 200 volts system is recommended as being the more economical. There is, we think, a fairly general consensus of opinion as to the commercial advantage of a low-tension system for short distances, and therefore, as we stated, we may accept the recommendation as being sound. Still more interesting would it have been, however, if we could have had Mr. Gordon's explanations for his advocacy of a high-tension alternating transformer system, a system in which accumulators cannot be used, and in which the transmission of motive power is practically (at present, at least), impracticable. This latter point—the transmission of power—may not, however, be one of any great importance, unless it can be shown that there is, or is likely to be, any large demand in the district for the supply of motive force.

The reference in the report to Major Cardew's opinions on the advantages and disadvantages of the high-pressure transformer system, as used by the Chelsea Company, do not appear to be of any material value, as these opinions really do not *compare* the advantages and disadvantages of the high and low-pressure systems, they simply state what the high-pressure system will do, and not what the low-pressure system will not do; much of what is said applies equally to the two systems, as, for example, when it is stated that "It is also a simple system to work, and the dynamos are simple, and can be made in easily replaceable parts."

Messrs. Latimer Clark, Muirhead & Co. express the opinion—"we are certain that low-pressure continuous current system will be found the most economical, satisfactory, and enduring"—and they adduce certain reasons for their belief; these, however, are, we think, no reasons at all; they say that certain good results have been obtained from the low-pressure system, and give figures in support of their assertion, but with reference to the high pressure they say *we are not aware* that any alternating, high-pressure, or transformer system, could show anything like the same economy;" if they cannot prove that the high-pressure system is not economical they cannot be competent to express an opinion on the relative merits of the two.

From the point of view of cost only the low-tension system, as recommended against Mr. Gordon's scheme, shows a considerable difference, a difference which the report states "placed the scheme (Mr. Gordon's) quite outside the favourable consideration of your committee."

RENARD'S VOLTAIC CELL.

THIS cell, the invention of Commandant Renard, will, it is claimed, give a considerable amount of energy in a very short space of time, or it will yield the same total amount of energy, gradually decreasing, with a duration of discharge proportionately increasing. The arrangement is of the bichromate of potash type, and its novelty consists in:

(*a*) The substitution of hydrochloric acid for some of the sulphuric acid.

(*b*) The suppression of the alkaline base, the bichromate being replaced by chromic acid.

Each cell consists of an elongated tube made either of glass or ebonite. The positive electrode is furnished by a very fine platinised silver tube (a *carbon* electrode is found to be unsuitable), and the negative electrode is a thin rod or wire of zinc.

The liquid used in this cell is composed of a mixture of two liquids, A and B, each of which is itself a mixture.

(*A*) consists of chromic acid and water, 0·530 of acid to 0·770 litre of water.

(*B*) consists of a mixture, in variable proportions, of hydrochloric acid and sulphuric acid.

If commercial hydrochloric acid be employed, it must be brought to a certain strength (18° Beaumé) by the addition of a little water. The requisite strength of sulphuric acid is obtained by mixing 0·450 kg. of acid at 66° with 0·800 litre of water, and the result should show 290° Beaumé.

The symbol, B, may be conveniently used in order to indicate the strength of the liquid, B, in percentage of sulphuric acid, thus B_{20} indicates that the liquid contains 20 per cent. of the acid.

It is stated that the total electric capacity of the cell does not vary or behave in any erratic way, and that many experiments show that the available energy per second is practically quintuple of that which can be obtained with the same apparatus charged with the bichromate of potash and sulphuric acid liquid of the ordinary bichromate battery.

The following are figures given by Renard in support of these contentions:—

Strength of the liquid.	Maximum current.
Mixture of liquid A with B_0	8·50 ampères.
" " " B_{20}	7·40 "
" " " B_{40}	6·80 "
" " " B_{60}	5·20 "
" " " B_{80}	3·50 "

Instead of sulphuric acid, sulphate of soda may be employed in liquid B, but the effect of the use of this salt is to reduce the total available energy per litre of liquid.

The best proportion in which to employ the constituents of the liquid is shown by the following table:—

No. of expt.	Joules obtained.			Composition of liquid.
	In the expt.	Per litre of liquid.	Per kilo. of liquid.	
1	44,900	200,000	170,000	HCl at 11° ... 200 cc. CrO_3........... 40 gr.
2	48,000	215,000	176,000	HCl at 11° ... 200 cc. CrO_3........... 60 gr.
3	52,200	233,000	185,000	HCl at 11° ... 200 cc. CrO_3........... 80 gr.
4	56,900	253,000	197,000	HCl at 11° ... 200 cc. CrO_3........... 100 gr.
5	56,000	250,000	184,000	HCl at 11° ... 200 cc. CrO_3 . ... 150 gr.
6	46,100	205,000	144,000	HCl at 11° ... 200 cc. CrO_3........... 200 gr.

The liquid employed in No. 4 experiment should be the best for general use, for it gives 253,000 joules per litre. This liquid, however, has the inconvenience of being a little viscous, and of sticking to the surface of the zinc—effects which conspire together to produce a diminution of energy which is quite appreciable. In actual practice the liquid which is found to be most suitable is that used in experiment No. 2.

It is unnecessary to amalgamate the thin zinc rod or wire which forms the negative electrode. By reducing the diameter of this electrode, the density of the electricity at its surface is increased, and at the same time the consumption of the metal per second and per unit of surface is reduced.

The great activity of these cells necessitates the provision of a considerable cooling surface, for there is a large amount of heat generated; this fact has determined the adoption of the tubular form of cell.

Electric Light at Fareham.—The introduction of the electric light into Fareham is likely to be attended with some difficulties. A memorial signed by 50 inhabitants was presented to the Local Board on Friday last against the erection of electric lighting poles, on the ground that they would disfigure the town. It appearing, however, that an action at law was already pending in reference to the matter, the Board decided to await the issue of events.

THE KENSINGTON AND KNIGHTSBRIDGE ELECTRIC LIGHTING STATIONS.

THE district over which the Kensington and Knightsbridge Electric Lighting Company has the right to supply electrical energy extends from Kensington High Street on the west to Albert Gate on the east, and from Hyde Park and Kensington Gardens on the north to the line of the Metropolitan Railway on the south. The original supply station erected by the company at Kensington Court commenced work in 1887, and has been continuously in operation since that time. It has been fitted with machinery capable of supplying between 20,000 and 30,000 lamps, and a second station at Chapel Place, Knightsbridge, has been constructed, which is able to supply another 20,000. The mains of the company have been laid in most of the principal streets of the district, and exceed 10 miles in length; they are all underground, and consist of concrete culverts made in the footways, having openings with removable covers opposite every second house. The conductors are bare copper strips resting on insulators, and the engineers claim that all future necessity for disturbing the surface has thus been avoided.

The system employed is the low pressure continuous current, assisted by accumulators to form a reserve of power and as a means of keeping the supply of current absolutely constant, and avoiding the chances of a breakdown. During the three years and a half the company has been in existence only one failure of the light has taken place, which occurred soon after starting. The working of this station, it is believed, is more economical than any other central station either in England or abroad; but, unfortunately, not being furnished with exact figures or data, we are not in a position to verify this statement.

The customers have paid for their electricity by meter record, and they appear to have been satisfied with the system of measurement.

The following particulars were issued by the company, and show the present condition of their system:—

Number of lamps	15,130
,, houses	178
Mains laid in miles	10¾
Horse-power	750

The amount of power can be easily increased to 2,000 H.P., sufficient to supply a total output of 100,000 lamps, which is considered to be the full amount required for the district.

On entering the station at Kensington Court while the plant is running, it cannot but be favourably noticed that the moving machinery is working in comparative quietude, and that the absence of noise and clatter is in marked contrast to the din prevailing at several other stations we have seen. The engines being coupled direct on to the dynamos, there is a corresponding gain in compactness and economy of floor space over machinery driven by long ropes or belts.

The buildings comprise a main shed, whose floor is some feet below the level of the street, in which are erected the boilers, engines, and electrical apparatus, accumulator galleries on an upper floor, as well as on the ground floor, together with sundry store-rooms and offices.

There is ample floor space for a further and large extension of plant, should the requirements of future demands necessitate providing for an increased supply. The company, however, considers that the present equipment will suffice for the coming winter, and that unless an unexpected demand arises to strain the limits of the effective output of the machinery, no heavy alterations to this station will be requisite for some time to come, nor to the other station in Chapel Place.

Each engine and dynamo is fixed to a common bedplate. The engines are of the Willan's type, and are provided with fly-wheels to ensure greater steadiness in driving the dynamos, which, as before mentioned, are coupled direct. The Kensington Court station is equipped with four engines of 200 H.P., driving the same number of large Crompton dynamos, furnishing currents at 200 volts pressure, suitable for the three-wire system (on which principle the whole of the circuits will eventually be worked), and also three smaller engines of 80 H.P., each driving a single magnet upright Crompton dynamo. The steam power is developed by three sets of boilers of 250 H.P. capacity, constructed by the Babcock and Willcox Company.

Massive leads are taken from the dynamos to switchboards erected in a small gallery specially set apart for the purpose, and by means of these every manipulation connected with charging, coupling, and other regulation of the currents is performed. The entire board has been designed in a thoroughly workmanlike manner, the mechanical engineer showing himself as prominent in the construction of the details as the electrician does in those points where his special knowledge is necessary. Instance the switch used for adjusting the number of accumulator cells for general regulation—the lever employed for working this switch has much of the character of those that are fixed in the signal boxes on railways for controlling the signals and points, and is of sufficient strength to withstand any wear and tear or rough usage that it will be likely to meet with. The electrical contacts present large surfaces, and much care and forethought has been exercised in ensuring good contacts between the parts when they are intended to operate.

In order to prevent, as far as possible, the loss between the terminals of the secondary batteries, the copper leads to the switchboard have a heavy section in the form of an H girder, which gives a very rigid conductor of ship-shape appearance.

There are several sets of accumulators, and of these two are placed in a stable at some distance from the charging station to assist in maintaining an even potential throughout the mains. A set is an aggregation of 56 separate cells of the Howell type arranged in series. Each cell of the battery contains 61 plates, and their dimensions are 8½ inches square by ¼ of an inch in thickness. The receptacle in which these 61 plates are placed is of lead with burned joints, and considerable attention has been paid to secure good insulation for the battery; each cell stands upon a plank painted with acid-proof pigment, and this is again insulated from the main frame by glass insulators. All timber in the supporting frame is painted with the above acid-proof application; while, not to neglect any means for preventing leakage, the contractors have paved the floor of the accumulator room with a special compound of bitumen and slate dust, a composition not only acid-proof but possessing good insulating qualities.

The normal output of the accumulators, or what may be better called the average discharge per hour, is 250 ampères, and the maximum allowed under contracts which must not be exceeded is 500 ampères. It would only be on an emergency that they would be discharged at the latter rate.

Aron meters are in use for measuring the current supplied from the stations, and the officials employed there speak very highly of their accurate performance in registering the precise amount of current consumed within a limit of error, so it is said, of less than a half per cent.

The Crompton system of underground mains, in use throughout the district, has been in successful operation for some years. The conductors are bare copper, supported on glass insulators in concrete culverts, under the footways. The conductors are composed of copper strip, one inch wide by a quarter of an inch thick; in some cases two or more strips are superimposed, supported at intervals in the culverts on glass insulators, which are arranged in sets, each set placed under a surface box having a removable cover, so that the insulators can be examined or replaced, or connections made to adjoining houses without disturbing the surface of the footway or roadway. These copper strips are strained tight, and held up by arrangements which can only be properly described and shown with the help of drawings. Such straining or fixing apparatus must be employed on straight runs, at certain intervals, depending on the weight of the conductors, and at points where the conductors deviate considerably from the straight line.

As the company, represented by the secretary and the contractors and their assistants, have been unsparing in their pains to render the installation of the electric light in their district as big a success as possible, it is to be hoped that the public, who occupy the houses along the route of the company's mains, will avail themselves to a large extent of the facilities thrown in their way, and use the electric current in such quantity as will suffice to somewhat recoup the Kensington and Knightsbridge Company for the heavy outlay to which it has been put in starting its system.

ELECTRIC TRACTION AT SALZBURG.

[FROM A CORRESPONDENT.]

A VERY interesting electrical tram line for the conveyance of passengers will be opened in a few days at Salzburg for public traffic.

To an almost perpendicular declivity of the Rönchberg there is affixed a cable line, worked by electricity, with an exactly vertical track of the cars. The considerable height of the installation (75 metres) and the extensive arrangement for the electric working, secure for the undertaking a significance, though in its nature and outward form the name "passenger conveyance," in the sense of the lifts at hotels, would be most suitable.

As far as the shore of the Salzach the spectator perceives the slender iron framework of the line, with a double track for an ascending and a descending seat. The lower station contains, in addition to the entrance and departure platforms, the battery chamber, containing 126 accumulators of large make, supplied by the Swiss Oerlikon firm, and which supply the electrical energy required for the ascent. The electricity for charging the accumulators is supplied by the dynamos of the Salzburg electrical works, which have been in operation for some years. For this purpose a special cable lead has been laid down, so that the accumulators can be charged during the daytime, when the dynamos are not required for the supply of light. It is therefore hoped that this installation will considerably increase the remunerative character of the works.

At the upper station is the electromotor which acts by a simple transfer to rollers placed in juxtaposition, over which runs the bearing rope of the travelling seats.

The entire installation has been executed by the firm Siemens & Halske, who constructed the Salzburg electrical works and then handed them over to a limited liability company. The height of the lift, as already signified, is 75 metres, the weight of a travelling seat is 1,200 kilos. Each seat can accommodate 12 passengers, who in a few moments can be raised to the summit of the Rönchsberg.

The fare proposed is 20 kreuzers each person for the ascent and 10 for the descent, which, with regard to the small distance traversed, cannot be regarded as very moderate. A restaurant and an extensive park are projected on the level of the upper station.

Tenders for Lighting Sofia.—The Foreign office has issued the following notice, dated August 2nd :—"With reference to the notice published in the middle of last May respecting tenders for lighting the town of Sofia by electricity, a despatch has been received at the Foreign Office from her Majesty's Agent and Consul-General in that city, stating that the adjudication will take place in the course of the next six weeks, and that any British firms desirous of competing should lose no time in communicating with Monsieur D. A. Zenow, of Sofia, or directly with the Mayor of that city, Monsieur D. Petkoff."

REVIEWS.

The Electrical Engineer's Pocket-Book. By H. R. Kempe, M.I.E.E., A.M.I.C.E. 1890. Crosby, Lockwood and Son, London.

The aim and object of this handy book of reference cannot be better explained than by quoting the author's own words. "In compiling this book my aim has been to produce a book which should, as far as possible, truly accord with its title, viz., a pocket-book of useful "modern rules, formulæ, tables and data"—the matter selected being such as is required for daily use in practical electrical engineering and its various applications to the industries of the present day. So multifarious are the data required, that every person engaged in the practice of electrical engineering must have experienced the want of such a manual."

The information which the author gives has been (he remarks) "carefully condensed, and only that which, in the practical experience of myself, and of others with whom I have been associated, has been proved to be of constant value, has been included." The book extends to about 250 pages, and includes numerous illustrations. It is divided into twenty-one sections, as follows :—(1) Weights and measures; (2) Units; (3) Temperatures; (4) Electro-Chemistry, Primary Batteries, and Accumulators; (5) Electro-Metallurgy; (6) Current; (7) Resistance; (8) Capacity; (9) Galvanometers; (10) Fault Testing; (11) Wire; (12) Insulated Wire; (13) Electric Light Leads; (14) Electric Light, Dynamos, and Motors; (15) Rules and Regulations; (16) Telegraph Apparatus; (17) Telephones; (18) Miscellaneous; (19) Mathematical Tables; (20) Foreign Money; (21) Dictionary of Technical Terms.

It immediately strikes one with surprise that in the above subdivisions of practical electrical engineering, no mention whatever is made of submarine telegraphy. The omission is evidently intentional, as, beyond one mention in the index, "Cable cores, size of," this important subdivision of electrical engineering is apparently entirely omitted, save that, in "Miscellaneous," is found a diagram and note for "sheathing wires for cables," otherwise "submarine," does not appear in the index. Of course, there are formulæ and descriptions of "fault-testing;" but as these are applicable to ordinary insulated electric wires, they cannot be credited to submarine work exclusively.

Under "Temperature" will be found—an arrangement very handy for reference—formulæ for the effect of temperature in the electrical resistance of various objects, such as copper, German silver, platinum silver, platinoid, gutta-percha, *and* India-rubber. The latter is given, it is believed, for the first time in any book, the writer not being aware of this useful information having been previously published. Although manufacturers are aware of the behaviour of India-rubber under the influence of temperature, yet this information has been invariably kept to themselves; the subject, generally speaking, being a sealed one. Is it because so little is known about it? At page 20 will be found a table of great value on this point: "Dividing coefficients for correcting the observed resistance of *India-rubber* at any temperature to 75° Fahr." Comparing this with a similar table for gutta-percha, it will be found that whereas G.P. alters from 1·00 at 75° to 1·982 at 66°, India-rubber only varies from 1·000 to 1·244 at 66·5°; a very marked difference in the influence of temperature on the two insulating substances. The author, in referring to India-rubber, is presumably understood to refer to "pure" rubber only, as *vulcanised* rubber is nowhere referred to. This is somewhat remarkable, considering the various qualities of this material, and the prominent position it now occupies as an insulator for electric light cables.

Under the heading of "Capacity" will be found formulæ for finding the inductive capacity of wires insulated with gutta-percha; and it is added, "for India-rubber the values are about 10 to 15 per cent. less," but as to the capacities of other material no mention will be found.

Nor is any allusion made to cables insulated with paraffin or other substances whose inductive capacity is considerably less than that of gutta-percha. As these forms of cables are very largely used abroad and also at home, especially for telephonic purposes, it is a matter of regret to find no mention made of them. But there appears to be an entire omission of any form of telephonic cable, whether underground or aerial, even the four-wire post-office form, and the overground "twist" seem to have been omitted. Under the same head of "Capacity" will be found a very useful and valuable "Loss of Charge" table showing approximate percentage of charge lost in a cable after 20 seconds' charge and one minute's insulation, corresponding to various values of F.R. ("capacity per knot × insulation per knot"). The test for percentage of loss is an exceedingly valuable one, and with an ordinary electrometer the condition of an insulated wire can be immediately judged without the necessity of calculation. Too little value has hitherto been placed upon this form of testing, and where definite results are required without the mathematical values, then the "loss of charge" test is the quickest and best of those known.

Under the heading of "Electrification," page 59, there are some remarks of so valuable and so perfectly reliable a character that a reproduction is desirable, as the particular attention of those engaged in correct testing should be drawn to it.

"The galvanometer deflection in the insulation test should be perfectly steady; unsteady reading, provided connections are well screwed up and battery is in good condition and well insulated, means a faulty cable. The deflection will gradually decrease whilst the battery is kept on, the decrease (called *electrification*) being rapid at first and then gradually slower. The decrease will be quicker at a low than at a high temperature. It is greater with India-rubber than with gutta-percha." "It is of very great importance to have both ends of the cable core well trimmed, and quite dry when testing. The trimmed ends should be dipped in melted paraffin wax." To those engaged in testing and wishing to obtain reliable results, better instructions cannot be recommended.

In the section given to "Wire" will be found a large amount of very useful information, commencing with the "standard wire gauge," to which a note is appended. "This gauge is the only legal standard wire gauge for the United Kingdom." It is, however, not the only one in use, for the B.W.G. is still very largely employed. A comparative table of wire gauges—that is, the S.W.G., the B.W.G., and the American B. and S., is very handy; but the B.W.G. can be found on referring to "Glover's" useful tables, of which a large abstract has been made.

The section on "Insulated Wire" concludes with the following "general observations": "Too much care cannot be taken in making joints; a defective joint, although it may not for a time so far lower the insulation as to cause a serious leakage of current, is almost certain to go completely bad sooner or later. Similarly, an insulated wire which has an insulation resistance of several megohms (an insulation which is amply sufficient for working purposes, provided it remains constant), would be almost certain to fail sooner or later, if its normal insulation were several hundred megohms."

In the section "Electric Light Leads," the Board of Trade limit is given at 2,000 ampères per square inch of section, but calculations are usually made upon the 1,000-ampère limit; this is apparent in some tables given further on. It is pleasing to find that reference is frequently made to the work done by the late Robert Sabine, for in electric lighting several of his tables are to be found. The instructions given by him for the mechanical tests (see p. 131) for insulated electric light wires are worthy of consideration; but Sabine was one of those who worked before their time.

There are several other points to which attention might be drawn, notably, to a large amount of very useful information included in the "Miscellaneous" section, but space hardly permits of much further reference. However, the tables at the end of the work will be found most useful and valuable, and tend to render the book very handy and complete.

The index is of an excellent character, and much time and labour must have been spent in rendering this as complete and correct as possible. So far as examination goes, it is about as good an index as can be met with. The work concludes with "a concise dictionary of electrical and technical terms in general use," which will be found of advantage to the many who have not been electrically brought up. As a very useful and handy help to those engaged in the various electrical industries, this work is strongly commended, and the author may fairly be congratulated on the successful carrying out the aims professed in his preface.

G. E. P.

Galvanic Batteries, Accumulators and Thermo Batteries. A Description of the Hydro and Thermo-Electric Sources of Currents with especial reference to practical requirements. By W. PH. HANCK. (Die Galvanischen Batterien, Accumulatoren und Thermosäulen Eine Beschreibung der hydro und thermo elektrischen Strom Quellen mit besondern Rücksicht auf die Bedürfnisse der Praxis). Third edition. Vienna, Pest, Leipzig: Hartleben.

This work forms a volume of the "Electro-technical Library," issued by the publishers. The author, indeed, says in his preface, perhaps too modestly, that batteries must now seem to the electro-technicist merely the outgrown "diseases of the childhood of applied electricity." The substitution of the dynamo for the battery has been indeed a revolution. It has taken electrical research out of the hands of chemists and handed it over to mechanicians, and probably all the results of the change have not been favourable to scientific progress. Herr Hanck mentions that many a promising improvement has disappeared from the scene or has sunk into a subordinate position, and that his readers will have become suspicious of inventions which have come across the Atlantic or the Channel, and cautious concerning French discoveries, though guaranteed by the names of celebrities. In the present addition, in place of dazzling novelties, the author has inserted merely matter which has stood the test of experience.

Accumulators naturally occupy a considerable space. As regards thermo batteries, the missing link has not yet been found which should connect the furnace at once with the battery without the costly intervention of the steam engine and the dynamo or their equivalents.

The Electric Light and the Lamps, Carbons and Illuminating Bodies hitherto employed. By Dr. ALFRED RITTER VON URBANITZKY. (Das elektrische Licht und die hierzu angewandten Lampen, Kohlen, und Beleuchtungs körper.) Third Edition. Vienna, Pest, Leipzig: Hartleben.

When a reviewer has found it possible to make favourable mention of a book it is always satisfactory for him to find that the public has endorsed his judgment so that successive editions of the work have been found needful.

In the present case a thorough revision and rearrangement of the subject matter has been found necessary in consequence of the rapid progress of electrotechnics. The present edition is in many respects a simplification. Thanks to the unceasing activity which is being displayed both in the theoretical and the practical sphere, a new light has been thrown on many points which were till lately a subject of doubt and controversy. The description of glow lamps, which in the two earlier editions occupied merely 13 pp., now extends to upwards of 50, although the author evidently eschews superfluous verbiage.

We think that electricians who already possess a copy of the first or second edition, will find it advantageous to add the present impression to their libraries.

LINEFF'S ELECTRIC TRACTION SYSTEM.

THIS letter came in too late to take its place in our correspondence columns :—In your issue of last week you published a letter of Mr. Frank B. Lea on my new magnetic conductor.

I am much pleased with the impartiality of Mr. Lea's criticism, although I must beg leave to differ in several of the points touched upon.

To begin with, his fear that "the insulated rail sections would sink so much that they would be in contact at many points along the line with the internal conductor" is perfectly groundless. For this to happen two things are necessary: the breaking of the earthenware supports or tiles which are embedded in asphalte, and also the crushing of the latter around the exposed and blind rails. Considering that the crushing strain of both materials is very high, it is easy to demonstrate that the power required to crush in the conductor is enormous, compared even with the severe mechanical test applied by Mr. G. Kapp (heavy steam roller), and the existence of such heavy weights in public streets is simply out of the question. A good concrete bed for the conductor is, of course, a condition *sine qua non;* but so it is for the running rails and the paving between them, and consequently this does not involve any extra outlay. Sketches of my conductor have appeared in most of the technical papers, and Mr. Lea will be able to judge for himself that very careful attention has been paid to the mechanical requirements. The magnetic rails are not only supported by such a strong material as earthenware embedded in asphalte, but are, moreover, securely interlocked by the latter, and all engineers know what a capital foundation for machinery this material makes, and how it takes up vibrations and strains.

If Mr. Lea had been present at an experiment I made with two lengths of magnetic rails imbedded in asphalte, when it took about four hours for two men with sledge hammers to detach the rails from the asphalte, he would have more confidence in the resisting power of my conductor.

Mr. Lea is quite right in refusing to recognise any similarity between the action of a heavy steam roller with the "ceaseless wear and tear of every day traffic;" but he is wrong in assuming that the latter is more dangerous to the efficiency of my sealed conductor. The experiments I have made in this direction lead me to conclude that this ceaseless rolling of cart-wheels will keep the asphalte round the rails compressed, thus preventing any possibility of leakage. Moreover, the wear and tear of asphalte is a quantity well known, and large cities, like Paris and Berlin, use it almost exclusively for paving.

With all respects to Mr. Lea's electrical training, I must decidedly contest his criticism as regards surface leakage. The well-known theory about the weakest link of a chain cannot be applied to surface leakage, as the latter does not depend on the quality of insulating material, but merely on the state of dryness, or otherwise, of the surface. Telegraph engineers know the fact well, and while getting in dry weather an insulation resistance of, say 20—30 megohms per mile, this resistance will fall to perhaps 200,000 ohms in wet weather. Of course, it would be absurd to record the yearly average insulation of the line either at the former or the latter figures, but it must be some mean quantity depending on the number of wet and dry days during the year.

About the joke as to the extraordinary weight of passengers in Mr. Kapp's calculations, I will say nothing. I should like only to point out that the car referred to was intended to accommodate 52 passengers, similar to those used by the West Metropolitan Tramway Company. If Mr. Lea will take into account the extra weight of car and motor necessary for traction by accumulators, he will find the weight of the latter mentioned by Mr. Kapp quite in accordance both with American and continental practice.

In conclusion, I must add that, if one had to mind all friendly "fears" and "doubts," no invention would be possible. But I believe Mr. Lea wishes me well, and declares that no one would be more pleased than himself if such fears should prove illusory in actual practice, and this I hope to demonstrate to him very shortly.

ALEX. L. LINEFF.

ELECTRICAL TRADES SECTION LONDON CHAMBER OF COMMERCE.

A MEETING of the section was held at Botolph House on Wednesday, Mr. Crompton in the chair.

The first business before the meeting was to receive the resignation of Mr. Trotter as technical correspondent.

Mr. CROMPTON regretted very much that Mr. Trotter, on account of other duties, was obliged to withdraw from the office. His position as chairman had only been made possible by the capability of Mr. Trotter. He thought the thanks of the section were due to him for the able manner in which he carried out technical matters relating to the section.

A vote of thanks was passed, and Mr. TROTTER responded.

Major FLOOD PAGE said with reference to the appointment of a successor, he would have a proposal to lay before the section at the next meeting; in the meantime, he hoped the matter would be left over.

A resolution was passed in accordance with the wishes of that gentleman.

OVERHEAD WIRES.

The section next considered the reply of the Board of Trade to the resolution passed by it at its last meeting with reference to clauses 9 and 12 of the Board of Trade regulations relating to the insulation, &c., of cables, and the suspension of conductors.

The CHAIRMAN incidentally remarked that the effect of the regulations had been, in one case, to run up the cost of a certain cable used for street lighting from £28 to £75 per mile. The reply of the Board of Trade amounted to a blank refusal to reconsider the matter.

Major FLOOD PAGE moved, and it was resolved, that the chairman be requested to draw up a short statement of the disadvantages and hindrances to the electrical trade of some of the Board of Trade regulations, and to send it to the secretary of the Institution of Electrical Engineers, together with the resolution of the section already signed, and a copy of the Board of Trade's letter, and a request for the appointment of a committee of the Institution with a view to meeting a committee of the section for the purpose of considering and inducing the Board of Trade to reopen the matter.

PATENT LAW REFORM.

The report of the Manchester Chamber of Commerce was laid before the section. The report points out that the Patent Law at present allows of considerable abuse, *i.e.*, bogus inventions are very frequently patented in order to prevent the possibility of other inventions of a similar class; and it suggests that the law should be so amended as to make such abuse impossible.

The SECRETARY said the Chemical Section of the Chamber had considered the matter, and recommended the appointment by the council of a representative committee of the various sections interested in the matter, with a view to making some practical suggestions.

A MEMBER thought the law of disclaimer should be abolished.

Another MEMBER pointed out that the section was only interested to a very small degree.

It was resolved to address the council to the effect that should it think fit to appoint a committee, the Electrical Section would assist as far as it can, and be prepared to appoint delegates.

THE FRANKFORT ELECTRICAL EXHIBITION.

The SECRETARY laid on the table a copy of the regulations.

Major FLOOD PAGE took occasion to point out that the date for sending in exhibits has been extended in favour of foreign exhibitors to September 30th.

THE EDINBURGH ELECTRICAL EXHIBITION.

The SECRETARY read a letter from the committee, requesting the section to send in the names of jurors nominated by it.

It was resolved to address the committee something to the following effect:—The Section regrets that the committee of the Edinburgh Electrical Exhibition did not avail itself of the opportunity of the presence of the Institution of Electrical Engineers in Edinburgh to confer as regards the appointing of jurors; that as the section is informed that it is not the intention of the Institution of Electrical Engineers to appoint jurors, it regrets that it will be unable to do so; and further, the section points out the inconvenience arising from the lateness of the application, when most of the members have already made arrangements for their holidays, &c.

RAILWAY RATES.

Mr. TROTTER produced the following draft classification issued by the Board of Trade for those items of the merchandise traffic which specially concern the electric trade, and observed that on the whole the trade had reason to be satisfied.

	Old classification.	Clearing House.	Class in deposited schedule.	Class proposed by Chamber of Commerce	Class recommended by Board of Trade.
Dynamos in cases...	2	3y	Omitted	2	2
Batteries, packed...	3	3	3	2	3
Sulphuric acid	4	Special	Omitted	C	not dealt with
Telegraph batteries	3	3	Omitted	3	3
Electric storage batteries	2	2	3	2	2
Cables................	4y	4y	4	3	3
Carboys, not glass, empty, not returned	4	4	Omitted	4	4
Carboys, empty, glass	3	4	Omitted	4	5
Cars, tramway	Special	Special	Omitted	Special	carriage class
Castings, iron, malleable	1	1	2	1	1
Castings, iron, steel, light	1	1	2	1	2
Castings, steel	3y	1	3	1	3
Telegraph insulators	1	1	Omitted	1	1
Sheet iron annealed	1	1	Omitted	1	not packed B
Mouldings	3y	3y	Omitted	2	3
Telegraph posts ...	1	1	Omitted	1	B
Reflectors, glass ...	4	4	5	4	4
Sponge cloth	2	2	Omitted	2	3
Steel bars, bundles.	2	2	Omitted	2	2
Telegraph cable ...	4y	4y	Omitted	3	3
Wire, cotton covered	2	2	4	2	2

THE LIGHTING OF SOFIA.

The secretary produced a letter from the Foreign Office, the purport of which will be found in another place. The proceedings then terminated.

Electric Light in West Africa.—We are informed that the first installation of electric light in West Africa was started on May the 31st last, at the Gie Apponto gold mine on the Gold Coast. A Siemens compound dynamo supplies 15 lights to the stamp mill house, engines and boilers. The installation, which has caused a great sensation in the colony, was set up by Mr. J. A. R. Milton, formerly with Messrs. Woodhouse and Rawson.

NOTES.

Electric Lighting at Bromley.—The local syndicate for the electric public lighting at Bromley, Kent, has resolved that it will not favour any particular company in the carrying out of their scheme, but will employ its own engineer to get out estimates and then invite tenders from some of the best firms.

Bristol and the Electric Light.—The question of the desirability of adopting the electric light for the illumination of the streets is occupying a good deal of attention at Bristol. The Electric Lighting Committee recently visited London and Chelmsford, and at their last meeting decided to proceed to Bradford.

Electric Lighting at Woking.—A public meeting was held on Tuesday evening to consider the desirability of lighting the town by electricity. After a discussion a vote was taken, 24 against 5 being in favour of lighting the town. It is probable that a further meeting of ratepayers will be held on the subject.

Lighting of the Hotel Metropole, Brighton.—With reference to Messrs. Verity's letter, Messrs. Benham and Froud say, "We wish to take the credit for nothing more nor less than the work we actually executed. If you will kindly refer to the memorandum we sent you, with our brief notice, you will see we describe them as the 'principal fittings,' and so undoubtedly they are, comprising (1) the 'electric sunlights' for the whole of the magnificent suite of three public dining rooms; (2) the whole of the private sitting room electroliers; (3) the principal vestibule electroliers; (4) several hundreds of portable table pillars for the bed rooms. We have not stopped to enquire whether one, four, or forty other houses also supplied fittings, nor have we stated that the designs were ours, the drawings having, in point of fact, being supplied to us by Mr. Holland."

Electric Lighting in St. Pancras.—A special meeting of the St. Pancras Vestry was held on Wednesday night to consider the report of the committee mentioned in our last and present issues. An amendment was proposed, referring the report back, but this was negatived, and the report was finally adopted.

New Spanish Cable.—The *Standard* says that the new Spanish Minister of War, General Azcarraga, has resolved to proceed at once with the laying of a telegraph cable between Spain and her stations on the coast of Morocco.

Appointment.—We hear that Mr. A. R. Bennett, formerly of the National Telephone Company, has been appointed engineer-in-chief to the Mutual Telephone Company.

Electric Traction at Chiswick.—The members of the Chiswick and Brentford Local Boards have expressed themselves so satisfied with the Lineff magnetic conductor that they have given their consent to its adoption on such portions of the West Metropolitan Tramways as are under their respective jurisdictions. The only remaining local authority whose consent must be obtained is the Hammersmith Vestry, to whom two alternative schemes will at once be submitted. The first refers to the application of the Lineff system to the line from Young's corner to the Uxbridge Road Station terminus; and the second from Young's corner to Hammersmith Broadway. As soon as their consent is given, the work of laying down the conductor from Kew Bridge either to Uxbridge Road station or to the Broadway will be at once proceeded with. The West Metropolitan Tramway Company has instructed Mr. C. Nicholson Lailey to prepare a report on the reconstruction of the line.

Central Station at Verona.—A central electric light station is now being erected in Verona, according to the plans of Mr. Eugenio Vitale, the Italian representative of Messrs. Schückert and Co., of Nuremburg. The station will be completed in a few months, and will have a capacity of 3,000 lamps. Of these, 30 arc and 1,200 incandescent lamps are to be put into operation this month. The three-wire system of distribution, in conjunction with feeders, has been adopted, the conductors being placed overhead. The steam plant has been supplied by Messrs. Tosi & Co., the conductors by Messrs. Pirelli & Felten and Guilleaume, and the electrical apparatus by Messrs. Schückert. The station is the property of a co-operative society.

Lyons National and Colonial Exhibition, 1892.—The project of a great national and colonial exhibition has just been adopted in France, to take place in Lyons during the year 1892. Two sections will be international: silk and electricity.

English and French Submarine Cables. — Mr. Raikes, in the House of Commons, in reply to Mr. Henniker Heaton said: I have to state that a substantial profit will no doubt result from the purchase of the submarine cables between this country and the Continent, but it would be premature at present to estimate the amount of that profit in view of the condition of the cables. As the House is aware, some of these cables are very old, and it is possible that before long a considerable expenditure may have to be incurred in renewals. Not only so, but the necessity for additional plant has arisen, and a large sum will be spent in the course of the current financial year on a new cable and land line. The number of words in Anglo-French telegrams has risen from 13,376,333 in the year to March 31st, 1889, to 15,495,791 in the year to March 31st last. Other telegrams have passed over the Anglo-French cables, but I am not able to give separate particulars with regard to them. In answer to a further question by Mr. Henniker Heaton, Mr. Raikes said that he had no knowledge of what had passed in the French Chamber. It was possible that it might be necessary there to ask for a vote for a cable between France and England, but it was not necessary to ask Parliament for the money for a cable to France.

The Institute of Medical Electricity, Limited.—This Institute has been removed to larger and more commodious premises at 35, Fitzroy Square, W. Increasing work and the need for being nearer the great medical centres of Harley Street and Wimpole Street induced the directors to make the change. They have taken one of the old-fashioned substantial residences on the Grafton Street side of the square, and it contains many large, light, and airy rooms, well adapted to the purposes of the institute. The drainage has been entirely renewed, and the house decorated from attic to basement. The apparatus has been carefully removed from the old quarters at 24A, Regent Street, and new has been added to it, so that greater facilities for electrical treatment are now available. We understand that increasing use is being made of treatment by "cataphoric medication," or the passage of drug solutions through the skin by means of electric currents. This method of obtaining strongly localised action has been developed from its experimental stage, and first brought into practical use at the institute under the auspices of Dr. Arthur Harries and Mr. H. Newman Lawrence. It has already proved very successful.

Edison's Greatest Work.—Dr. Lassar stated at the Medical Congress, now held in Berlin, that Mr. Edison intended, through his medical adviser, to communicate a novelty in the shape of an application of electricity for the removal of stone. This will be glad news, if true, for the operation for this disease is reckoned amongst the most painful; and if Edison completes this work, he will have achieved his greatest success, for the name of him who has alleviated pain goes down to posterity ever blessed.

Tenders for Electric Lighting.—Estimates are requested for lighting the public streets and buildings in Helston (Cornwall) by gas, oil, or electric lights, per annum, for the Town Council. Tenders to be sent to Mr. J. G. Plomer, town clerk, by 16th inst.

A Record in Dividends.—The *Gazette* notifies the payment from the estate of the late Mr. Ex-Alderman Hadley, 5, Knightrider Street, of a first and final dividend of one-sixth of a penny. The connection of Mr. Hadley some years ago with a submarine cable scheme will probably be still fresh in the memories of our readers.

Opposition to Electric Lighting Poles.—The Fareham Electric Light Company, having been made the subject of an indictment in respect of the poles which they have recently erected in the town, a mass meeting of ratepayers was held on Tuesday. A resolution was passed expressing sympathy with the company in its endeavours to introduce into the town a better and a purer light, and condemning the action of a privileged few in endeavouring to thwart the wishes of the ratepayers. The electric light company, it may be added, have entered into a contract with the Local Board, under which they are to light the streets of the town for a period of three years for the annual sum of £500, or £30 less than the price at present paid for gas. This matter has been referred to on another page.

Prevention of Vibration in Lamp Filaments.—To prevent excessive vibration of filaments of incandescent lamps, a method has been employed in which the loop end of the filament is steadied between metallic posts set into the glass bulb. When, however, this arrangement is used, frequent contact between the filament and these metallic posts soon weakens the former, removing, as it does, small particles at a time, and the life of the filament is materially reduced. It has also been found that the filaments, by their frequent contact with metallic posts, form grooves in the latter by melting away the material. In experiments made with the view of producing stops which will effectually accomplish the desired result, and at the same time insure the full life of the filament, George R. Lean, of Boston, has found that the stop or stops must be made of material which will not melt and that is non-combustible; and also that a stop composed of the same material of which the filament is made is best suited for the purpose. He, therefore, provides stops of carbon, they being secured to the apex of the bulb, and located adjacent to each other to receive between them the filament. When the air is exhausted from the bulb, a small short tube of glass is fitted in the hole at the end. The outer end of this tube is afterwards sealed. To secure the stops in place, the inner end of this tube is closed, and the stops are secured in the closed end.

Pole-Finding Paper.—Since the time when we first had occasion to notice Wilke's pole-finding paper, Dr. Oscar May, of Frankfort, who is the sole proprietor and maker of the paper, has improved the form in which it is issued to the public. No change has been made in the material itself, but the sheets of prepared paper being bound up with a stiff cover, instead of a limp paper back, renders its present form of issue much more convenient for carrying in the pocket, at the same time giving more protection to the paper, and thus preserving it in good working order for a longer period. Bound up with the pole-finding paper will be found instructions for its use, and claims as to its advantages over the expensive instruments which have hitherto been in general use for the purpose of detecting the direction in which a current is flowing. The indications being absolutely correct, even with as low a potential as a single volt, Wilke's P.F.P. affords a handy and speedy means of determining the direction of a current, or for the detection of leakage in conductors and other kindred faults. The paper can be obtained from Berend & Co., Fore Street, E.C., the sole representative of Dr. May in this country.

The Southend Electric Tramway.—Messrs. Crompton and Co., Limited, are running an electric tramcar along the pier at Southend. The engine, boiler and dynamo are situated under the arches near the entrance of the pier, and the current is conducted along the central rail for three-quarters of a mile down the pier. The car holds about 40 persons, and travels at the rate of about sixteen miles an hour, doing, in some three and a half minutes, the journey which takes nearly fifteen minutes by horse traction. The line, which has been carried out in a very expeditious manner, was certified by Dr. Hopkinson on Friday last, when he expressed himself highly gratified at the result. On Saturday afternoon, after a few trial runs, it was handed over to the Local Board for public use at four o'clock. Immediately, large numbers of people availed themselves of it, and all day on Monday (Bank Holiday) the car was well patronised. As this is a highly satisfactory exhibition of electric traction situated a short distance from London, it will no doubt be visited by everybody interested in this particular work. Messrs. Crompton inform us that they are willing to give any information to those who require it and will call at their offices before proceeding to Southend.

The Lane-Fox Patents.—It seems that Mr. Lane-Fox and his advisers are not going to get their own way without a struggle; perhaps not even then. Sir Frederick Bramwell, Mr. Swinburne, and Mr. Kapp are all agreed that the claims of the Lane-Fox Company cannot be sustained, and the Kensington and Knightsbridge Electric Lighting Company has opened communications with several others for the purpose of co-operating together for the formation of a defence association. The proposed basis for this, which we should be glad to see carried out, is as follows :—1. To defend any action that may be brought against any of them by the Lane-Fox Electrical Company, who are threatening to commence actions in respect of the letters patent owned by them, and alleged to cover the system of supply above mentioned. 2. To take such advice and collect such information as may be necessary for the protection of the rights of the several members of the association to use the system of supply above mentioned. 3. Supply companies to subscribe a minimum of £50, contractors £25, and owners of private installations £10, to be called up as required; this would entitle members, thus constituted, to claim that the association should defend any action to the extent of the funds subscribed, and any additional amount which may, from time to time, be voted in general meeting, which might be brought against them by the Lane-Fox Electrical Company, in connection with the above-named claims. 4. Should further funds be required, the members are to be called upon to sub-subscribe, in the ratio of the sums above mentioned, according to their respective denominations. 5. Any member of the association may retire at any time, in which event this association shall no longer be under any liability to defend any action which may have been brought, or may be brought, against the member in question.

What the Americans Say.—The *India Rubber World* states that Mr. Ferranti has surmounted the difficulty of jointing cables to carry 10,000 volts. This is scarcely borne out by a note which appeared in our last issue.

The Phonographic Doll.—The *Financial News* of Wednesday says :—"Rumours being current that there was some hitch in connection with the Phonographic Doll Company, our representative made inquiries at the offices of the company yesterday, and was informed by the secretary that the statement as to the company having been withdrawn from the public was incorrect. This gentleman declined to give any further information, and in reply to a question as to whether the company had gone to allotment, remarked that he was not going to be 'pumped.'"

The Manufacture of Cables in America.—Of the manufacture of cables in America, a rubber journal of that country says :—"Some day, perhaps, America will take a hand in submarine cable work, but the day seems far distant, as she looks on so complacently while cables are being landed on her shores or on those of neighbouring countries, and makes no attempt at participating in the labour and the profits."

The Etiquette of Journalism.—We have noticed from time to time complaints emanating from our English contemporaries respecting the cool manner in which articles have been abstracted from their columns and reproduced across the herring pond as original matter. We, too, on various occasions, have detected many productions of our own appearing in American journals as editorials, but we have rarely come across a more audacious case of piracy than that of which the *Electro-Mechanic* has been guilty, viz., the publication of our leading article on "Lightning Protectors" from the REVIEW of May 16th, without the slightest recognition of its origin. We are fain to believe that the source of papers which English journalists think may prove interesting to their readers is invariably acknowledged, unless through some oversight of rare occurrence, but we cannot give the American technical press credit for the same honesty of purpose.

Kemmler's Execution.—The following particulars of the end of Kemmler, the first man to suffer the extreme penalty of the law by death from an electrical shock, were telegraphed, on the 6th inst., to the *Standard* :—"The convict Kemmler was to-day executed by electricity at Auburn Prison, New York. The execution, which took place at seven o'clock in the morning, was a trying spectacle, as, owing either to imperfect regulation of the strength of the currents or faulty contact of the electrodes, the convict's death was not instantaneous. There were present in the chamber where the execution was carried out twenty-six persons, including several physicians, scientists, and officials. The unhappy man showed great nerve, placing and adjusting himself in the execution chair with perfect calmness. The lethal shock continued for eighteen seconds. Two minutes after the current was suspended there were evidences of respiration. As soon as possible the current was renewed and then cut off, but again respiration was evident, and a minute or two afterwards saliva issued from the mouth, the chest heaved, and a wheezing sound came from the throat. The shock was then applied for the third time, and Kemmler was pronounced to be dead. The physicians say that he was unconscious from the moment of the first shock. Smoke appeared at the back of the body, where the flesh was burnt by the intensity of the current. The voltage at the first shock was 1800. The duration of the first shock was seventeen seconds, after which it was supposed that Kemmler was dead. The spectators, however, were then horrified by the respirations being renewed, the entire body being racked in the efforts of the organs to resume their functions. The current was then started again. A convulsion was marked on the first application of the electric current, and the culprit was declared to be dead in 13 minutes from the first stroke. The flesh on the back was burned, and there was also a spot on the top of the head. The doctors who made the autopsy agree that unconsciousness set in immediately, and declare that death was apparently painless, notwithstanding the slight defects in the apparatus, which required a second contact to ensure death. There was a considerable charring of the body at the points of contact of the electrodes, and a minute hæmorrhage was found in the serous membranes and ventricles of the brain. The blood was fluid and dark in longitudinal sinuses, corresponding with the region of contact. The blood was carbonised, and there was a decided change in the consistency and colour of the brain, corresponding with the point of contact. Destructive changes in the blood corpuscles were noted. The consensus of opinion of the spectators was that execution by means of electricity is a failure, even if properly carried out, but that it was not instantly successful to-day because of the low voltage, or owing to a too short application of the current, or for both reasons. Had the current been maintained for 30 or 45 seconds at the first application, it is believed that there would have been no possible question of a satisfactory result.

Telegrams from New York yesterday read as follows:—"Further particulars regarding the execution by electricity show that signs of dissatisfaction were made by the spectators when on the application of the third current smoke was seen to be curling from Kemmler's back. The warder, therefore, again gave a signal to open the switch, when the culprit's body in the chair was surcharged with four distinct shocks. After this no further movement was observed. Dr. Shrady, the editor of the *Medical Record*, has written a letter, in which he says that nothing has been gained over the ordinary method of execution. Science has triumphed, but the question of the humanity of the act is still an open one. The method requires elaborate preparations, involves the manufacture of new machinery, and, moreover, may endanger the lives of the executioners, and even the spectators. All the morning papers publish articles upon the execution, and the opinion is generally expressed that the law authorising execution by electricity will be repealed by the New York Legislature at an early date. It is also held that the various criminals now waiting execution in the New York gaols should be granted a stay of their sentences until the law has been repealed.

Trial of an Electrician for Manslaughter.—At Bristol, on Wednesday, an amateur cyclist, named Henry Askham, electrical engineer, was tried before Mr. Justice Denman, charged with the manslaughter of Thomas Davis, at Pensford Hill, in May last. In defence, it was contended that the prisoner could not be held accountable for Davis moving into the track of the machine. The jury, after retiring, returned a verdict of not guilty, and the Judge, in discharging Askham, suggested that he should do something to help the widow of deceased.

Electrical Aids to Sport.—Advertisements have recently been seen in the daily press to show that Mr. Gunn, the famous Nottingham cricketer, made his recent memorable score against the Australians by the aid of a "Harness's electropathic belt." Judging from the comparatively few runs he has since made, we can only conclude that his long innings at "Lord's" robbed that belt of its virtue. At all events, if Mr. Gunn could only refer to some back numbers of the REVIEW we feel sure he would do nothing less than explode.

Exhibition at Frankfort-on-the-Maine.—Appended are a few of the rules for the forthcoming exhibition:—The exhibition will last five months; it will be opened on May 15th, 1891, and closed on October 15th, 1891, the committee reserving themselves the right of altering above dates. Only such objects will be admitted to the exhibition which can be brought under the following heads:—Motors for electrotechnical purposes, as steam, water, air or gas motors, with the necessary appliances for producing steam, &c.; production of electricity; transmission of electricity, with all transmitting and supplementary apparatus; accumulating and transforming apparatus; transmission of electric power with a view to industrial purposes; electric light, with special subdivision for fittings of all kinds; telegraphy and telephony; electric signalling, as applied to railways, mines, nautical and military matters and private houses; protection against fire, thieves, and lightning; electro-metallurgy and electrolysis; measuring instruments, scientific apparatus, acoustic and optical instruments relating to electricity, school-teaching apparatus; electricity as applied in medicine and chirurgy; electrotechnical literature. Mention must be made whether the objects are for sale and at what price, and if required the words "for sale" must be affixed. Cost of fire insurance to be borne by the exhibitors. Insurance cared for by the committee, the value to be conscientiously given on the schedule of applications. The committee provide working power and main transmissions, as well as the necessary quantity of electricity, steam, water, and gas. Should the exhibition close with a surplus, up to one-half of the same will be applied to a total or partial repayment of expenses incurred for space and power by exhibitors. Exhibitors are bound to insulate all wires for electric currents belonging to their exhibits, and to guard the same in such a way as to exclude all possible danger to the public and the buildings. The laying of cables or setting up of wires can be done by special permission of the committee only and under the supervision of the latter's *employés*. Whenever the committee should think fit, such cables are to be fixed by their own workpeople at the exhibitor's charge. All applications and communications to be addressed to "An den Vorstand der Elektrotechnischen Ausstellung, Frankfort-on-the-Maine."

American Patent Office.—The American Patent Office has recently given an example of its method of work. Two patents issued on the same day read as follows:—"Claim 1, Patent 432,131, dated July 15th, 1890, reads:—1. In a current regulator or rheostat, the combination of a surface of non-conducting material coated with a conducting substance, and in which the conductivity decreases from one place upon the surface to another, means for connecting a conductor with a portion of the conducting material of greatest conducting power, and a movable contact device movable over the contact surface, and formed with a series of flexible fingers resting upon said conducting material. Claim 1, Patent 432,279, dated July 15th, 1890, reads:—1. In a current regulator or rheostat, the combination of a surface of non-conducting material, provided with a coating of conducting substance which gradually decreases in breadth from one point to another, means to connect a conductor with said coating of conducting substance at the point of its greatest breadth, and a contact-piece movable over said conducting surface with a contact face of greater width than the decreasing breadths of the conducting surface, whereby as said contact piece is moved over said conducting surface the area of its contact face in contact with the conducting surface will gradually decrease." We fear Americans beat us in many things; in patents we are miles behind.

NEW COMPANY REGISTERED.

Grange Syndicate, Limited.—Capital £2,000 in £5 shares. Object: To develop and experiment upon Groth's Electric Tanning System in conjunction with the patentee upon terms of an agreement with Mr. L. A. Groth. Signatories (with 1 share each): L. A. Groth, C.E., 3, Tokenhouse Buildings; T. W. Maule, L.C.C., 12, The Grange, Bermondsey; F. Fleming, Halifax; C. Clark, 20, Great St. Helens; A. Vinos, Sevenoaks; F. Whitcomb, 27, Endsleigh Gardens, N.W.; L. Tucker, Victoria Mansions, Westminster. Registered 1st inst., without special articles, by Courtenay, Croome and Company, 9, Gracechurch Street.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Lancashire and Yorkshire Electric Lighting Company, Limited.—The annual return of this company made up to the 9th ult. was filed 30th ult. The nominal capital is £100,000 in £5 shares. 127 shares are taken up, and £2 10s. per share has been called thereupon. The calls paid amount to £315 and unpaid to £2 10s.

Manchester Edison-Swan Company, Limited.—The annual return of this company made up to the 28th ult. was filed 29th ult. The nominal capital is £550,000 divided into 50,000 "A" shares of £9 each, and 10,000 "B" shares of £10; 20,000 of the former and the whole of the latter are taken up. Upon each "A" share the sum of £1 has been called, and upon each "B" share £10 has been called. The calls paid amount to £20,000 on the "A" shares and £100,000 upon the "B" shares.

Patent Electric Fire Lighter Company, Limited.—At an extraordinary general meeting of this company, held at the offices of Messrs. Heath, Parker & Co., 3, New London Street, Mark Lane, on June 23rd, it was resolved to wind up voluntarily, Mr. Wm. Finch being appointed liquidator at a remuneration of £10, with instruction to transfer the business to a new company to be called the New Electric Fire Lighter Company, Limited. The resolution was confirmed on the 10th ult., and duly registered on the 31st ult.

Key's Electric Company, Limited.—The statutory return of this company made up to the 24th ult., was filed on the 30th ult. The nominal capital is £15,600 in 3,000 ordinary shares of £5 each, and 600 founders' shares of £1 each, the whole of the ordinary shares and 450 founders' shares are taken up, upon the former 10s. per share has been called, and the full amount upon the latter. The calls paid amount to £1,896, and unpaid upon founders' shares £54. Registered office, 122 and 124, Charing Cross Road.

New Portable Electric Lamp and Power Syndicate, Limited (in liquidation).—The registered office of this company is now situate at 43, Coleman Street.

CITY NOTES, REPORTS, MEETINGS, &c.

The Anglo-American Telegraph Company, Limited.

The Marquis of Tweeddale presided in the absence of the Chairman, Viscount Monck, at the ordinary general meeting of the shareholders, held at Winchester House, last Friday, and in presenting the report (printed in our last issue), and accounts for the year ending 30th June, 1890, said the increase shown on traffic receipts, viz., £2,025 over the corresponding period of last year was satisfactory, because, in the first place, the period was the least profitable, and, in the second place, because he believed the increase was due mainly to the opening of three new offices in New York, which had brought the company in closer contact with the telegraphing public of that city. The revenue from those offices would no doubt be further increased as they became better known. It was also satisfactory to note that the whole of the company's cables were in good condition. There had been fewer faults to repair, which was in a great measure owing to the Duxbury cable (referred to on previous occasions), so that the expectations formed had been fully realised. Moreover, all the cables of the pool were in equally good order. One of the cables of the Western Union Company, after having been out of order for something like 13 months, was now repaired, at the great depth of some 2,500 fathoms. The company's traffic had been conducted with the usual accuracy and efficiency, and, he was glad to add, at a speed higher than had been achieved by any other Atlantic company. The directors had been, for the last six months, expecting a settlement of the dispute with the Paris and New York Telegraph Company, which had not yet been arrived at, and he had no notion as to what the decision would ultimately be. They observed that the company's working expenses had increased by about £5,692. The increase was almost entirely made up of one figure, viz., £4,352, spent in the establishing the three offices referred to, the balance being composed of a number of small items calling for no particular notice. Expenditure on repairs showed an excess of £2,023; that was really a satisfactory feature, since the repairs had been entirely of a character chargeable to revenue. For renewals, the expenditure had been extremely small, and amounted to £552 19s. 5d. only, consequently the whole of the interest upon the renewal fund had been credited to that fund, making it £968,861 18s. 7d., the market value of which was about £50,000 more; in fact, the renewal fund amounted to over a million. The terms under which the company acquired the Brest-Salcombe cable from the liquidators of the Submarine Telegraph Company were altogether satisfactory. He moved the adoption of the report and accounts, and was seconded by Sir Jas. Anderson.

A Shareholder was sorry that the whole of the interest had been credited to the renewal fund. There ought to be some limit to the extent of that fund.

Another Shareholder reminded the meeting that some time ago it was tacitly agreed that the renewal fund must not exceed one million. He thought that on the next occasion the directors should abstain from adding interest to that fund, since, with the value of the investments, it already exceeded the limit agreed upon.

Another Shareholder suggested that henceforward the whole of the renewal fund should be appropriated to the deferred shareholders, seeing that it had come entirely out of their pockets. (Cries of dissent.)

The Chairman was aware of the agreement referred to. It was most important the company should have an ample renewal fund. Its cables were growing older, and considerable sums might soon have to be spent for renewals.

The motion to adopt the report and accounts was carried, and the meeting dissolved.

City and South London Railway Company (late City of London and Southwark Subway Company).

The report of directors to the shareholders at the twelfth half-yearly ordinary meeting of the company, to be held at Winchester House, next Tuesday, at 12 o'clock noon states:—

During the past half-year both of the tunnels have been completed, the whole of the permanent way laid, and the underground stations finished with the exception of tiling, painting, and other small matters. The surface stations and the lifts are rapidly approaching completion, and the hydraulic pipes and electric conductors are laid throughout. At Stockwell depôt the inclined road leading to the tunnels is finished and in use, the two engines and dynamos for the electric power are completed, and the third or reserve engine and dynamo is nearly ready, the three engines in connection with the hydraulic power for working the lifts are also ready, and the engine house and carriage stores are roofed in. A portion of the rolling stock is ready for delivery, and it is expected the railway will be opened for public traffic at an early date.

The Bill for the extension of the line to Clapham has passed through Parliament, and received the Royal assent. By it the name of the company is changed to the "City and South London Railway Company."

The Bill referred to in the last report, and known as the Central London Railway Bill was thrown out in the House of Lords. Your directors will have to consider how far some of the advantages proposed by that Bill could be usefully provided by this company without the objections urged against that measure.

To meet the wishes of many of the larger shareholders notice has been given of a resolution to convert the share capital of the company into stock, so as to facilitate its transfer.

Mr. J. H. Greathead, M.I.C.E., the engineer, reports as follows:—

During the last half-year the remaining length of tunnel through the wet strata at Stockwell has been completed, and the permanent way and hydraulic pipes have been laid throughout both sections of the line.

With the exception of some small matters, such as portions of the glazed tiling and painting, the underground works from the City to Stockwell have been finished, and the buildings on the surface are in a forward state.

The lifts and signalling arrangements are approaching completion.

The engines for generating the hydraulic power, and the boilers for working all the machinery, are ready for starting.

The electric working conductor has been fixed throughout; two of the three electric generating engines have been erected; delivery of the locomotives has commenced, and some of the carriages are ready for delivery.

The London Road Car Company.

At the half-yearly meeting of the shareholders of the London Road Car Company (Limited), at the City Terminus Hotel, Cannon Street, on Tuesday last, under the presidency of Lieut.-Col. C. F. Colville,

Mr. George Offor in the course of a discussion which ensued upon the Chairman's motion for the adoption of the report said that at a previous meeting he had made allusion to the subject of the progress made with electrical traction. His remarks, however, were met with derisive laughter from some of the shareholders, and one of the directors went so far as to venture into prophesy, telling the meeting that not in their time would they see omnibuses propelled by electricity. Now, he (Mr. Offor) in justice to himself and as a warning to his jubilant friend, Mr. Hodgson, would like to read an account of what had recently taken place showing that in London the electrical omnibus was a fact. Only the other day there was seen in the afternoon coming down St. Martin's Lane, into Trafalgar Square, the first of the new line of the electrical omnibuses, which was driven by Mr. Ward, the managing director. It came down the street with one passenger inside, and two outside, going at a rattling pace, and went in and out the ordinary traffic without difficulty. Mr. Offor said that when he spoke on the subject at the last half-yearly meeting he did so with such a knowledge of the facts that he was able to form an opinion on it. He now said, therefore, that the day would come and at a not very distant period, when all their anxieties about the price of forage, and the health of their horses, would be at an end. He was pleased that the meeting had not that day met his remarks with derisive laughter, and he hoped they would go a step further, and when it came to the time to make an addition to the board of directors, that they would consider the qualifications of their candidates in the direction of their possession of some knowledge of electrical traction. (Hear, hear, and laughter.)

The Chairman, in briefly replying to Mr. Offor, said that he (the speaker) did not think they need discuss the question of electrical omnibuses. There was no doubt they would keep their eyes open when these 'buses appeared, but until then they were unable to do so.

The North Metropolitan Tramways Company.

MR. GEORGE RICHARDSON presided on Wednesday at the 41st half-yearly meeting of the North Metropolitan Tramways Company, held at Cannon Street Hotel. The report contained the following paragraphs:—"The Bill introduced into Parliament this year for authorising an increase of the share capital of the company to the extent of £100,000, and also for the use of electricity as a motive power for propelling the cars throughout the system, received the Royal Assent July 4th, 1890. Application has been made to the local authorities for consent to work some of their lines by this power." "The arrangements entered into with the General Electric Power and Traction Company, Limited, referred to in the last report for working the cars on the Barking Road section are in operation, and during the last half-year they have run 44,047 miles."

The Chairman, in moving the adoption of the report, commented briefly on these particulars. He said that the company had lost no time in applying to the London County Council and the West Ham Board for permission to use electricity, they being the two corporations having jurisdiction in the place where the directors proposed to try it. They did not intend to devote any of their money to experiments with electricity. If any person would come forward and make the installation, they would receive all the assistance the company could give, so long as there was no risk of spoiling a good traffic. The line at Barking was working now, and they would see the result later on. It was worked by contract at 4½d. per mile. With regard to the use of electricity elsewhere, in the United States a large number of lines were working by electricity, chiefly on the overhead system. He was not aware whether they could ever have that in this country, as there were difficulties in the way—the streets were narrow, and they would have to contend with the prejudices of the people. There were other systems, but steam was nowhere, as could be seen by a comparison of their dividends with the dividends on the North London Tramways Company.

The report was afterwards adopted.

The Cuba Submarine Telegraph Company.

THE directors' report and accounts for the half-year ending 30th June, 1889, were laid before the shareholders on their thirty-eighth general meeting, held at the company's offices, 58, Old Broad Street, E.C., on Wednesday last, Mr. Thomas Greenwood presiding.

The Chairman said the half-year had been a period of some little anxiety, but, on the whole, not by any means an unsatisfactory one. It was the second half of the first year of the reduced tariff; therefore, in making the comparison they must bear in mind that it was compared with the period when the rates were 25 per cent. higher. The shareholders would observe that the receipts were £23,671 in June, 1889, and £23,206 in June, 1890, a difference of only £465. Of course a larger number of messages had been carried. It sometimes happened that increased traffic was accompanied by additional working expenditure. That had not been so with the company; in fact, as compared with the previous corresponding half-year, it had saved £30. They might ask how it happened that the dividend was reduced from 9 to 8 per cent. The explanation was that during the last half-year an addition had been made to the undivided balance, whereas in the corresponding period of the previous year that balance underwent a large diminution, which would account for the missing £800. In the future they would compare what was fairly comparable—viz., the reduced rates in 1890-91 with the reduced rates in 1889-90. He was pleased to say that the receipts for July, the first month of the new half year, showed a comparative increase of nearly £150, which, if it continued, would mean an improvement for the whole year of some £900, or more than sufficient to make a dividend of 1 per cent. Provided the company was not interfered with by outside influences, there was no reason for supposing that its dividend would be further reduced. They were aware that a proposal was before the Spanish Government involving the making of another cable, *vià* the North Coast, which, if made, must inevitably attract to it a large portion of the company's traffic, and, at the same time, the Spanish Government had made a representation to the various telegraphic companies located in the Spanish colonies with a view to still further reducing the rates. Having already made a large abatement, it seemed a little unfair, especially as the Spanish Government was consenting to the extension of a rival company's line almost parallel with theirs. He need scarcely say the board was not prepared to consent to any abatement so long as they were threatened with the new line, and so long as the abatement was not a general one. To return to the accounts, a comparatively small addition had been made to the reserve fund, owing to so much money having been spent on the company's cables; but they might console themselves with thinking that the repairs to the cables made a large addition to the reserve unnecessary. The expenditure on repairs had been larger than in any previous half-year; they had now a complete duplicate system between Cienfuego and Santiago, and with the projected new cable between Batabano and Cienfuego, their system would be complete and in duplicate from end to end. Progress had been made with the new cable, and they might reasonably expect to hear of its completion before their next meeting. He moved the adoption of the report and accounts, and, in reply to a shareholder, explained that the steps the directors had ultimately thought fit to take legal action, with a view to setting aside the concession above referred to.

The motion was carried.

The Chairman next moved to declare dividends of 10 per cent. per annum, subject to income-tax, on the preference shares, and 8 per cent., free of tax, on the ordinary shares of the company, payable on and after the 7th inst.

The motion was carried unanimously. Mr. Alexander F. Low was re-elected a director, and Mr. John Gane reappointed auditor, and, with a vote of thanks to the board, the proceedings terminated.

The Maxim-Weston Electric Company, Limited.—The shareholders, at an extraordinary general meeting held yesterday, after hearing a statement of the company's affairs during the past six months from Mr. Gooding, the chairman, have resolved to wind up the company voluntarily and have appointed Messrs. Marks and Hodgson liquidators. It seems the company started with a nominal capital of £40,000 or £50,000, of which only £14,000 was subscribed. The private meeting held a few weeks since to ascertain the feeling of the shareholders with regard to subscribing more money, resulted in the promise of some £1,500 by way of debentures, a sum not nearly sufficient in the directors' opinion, to carry on the concern. The company is just able to discharge its liabilities amounting to about £300. The plant at the works is estimated at £7,000 as a going concern. Under the circumstances it was natural to suggest a reconstruction and this was done by Mr. Marks, who observed that there was still a gigantic field of work open to the company in the way of lighting. The proposal, however, found no favour with the meeting. A full report of the meeting will appear in our next issue.

The Berlin General Electricity Company.—The general meeting of the shareholders in the above company has just approved the increase of the share capital from 16,000,000 to 20,000,000 marks. The new shares are offered to the old shareholders at the price of 165 per cent. The issue has been guaranteed by a syndicate of bankers, who are to receive 5 per cent. for their guarantee. This increase of capital has been necessitated by the increasing extent of the company's business, it having now undertaken the working of the Halle Metropolitan Electric Railway, besides having concluded contracts with two other towns for the establishment of electric railways.

Elmore's Patent Copper Depositing Company.—The *Financial Times*, of August 5th, devotes a long criticism to the company, which has now been in existence for more than 18 months, and yet, according to our contemporary, has done no genuine work. The earnings of the company from its factory seem to be absolutely non-existent. It is hardly possible to suppose, says the financial paper, that even the "docile race" of shareholders will take up another issue of wire shares at a premium, when they learn that the vendors only value their patents at less than one-fifth of the price charged for them.

The Western Counties and South Wales Telephone Company, Limited, whose head offices are at 16, High Street, Bristol, have posted dividend warrants for an interim dividend for the half-year ending 30th June last, on the preference shares of the company, at the rate of 6 per cent. per annum.

The Pilsen, Joel and General Electric Light Company, Limited—A general meeting of the company will be held at the office of the liquidator, Mr. George Shead, 18, Laurence Pountney Hill, Cannon Street, E.C., the 5th September, 1890, at 11, when the liquidator's accounts, &c., will be produced.

The Byng Telephone Company, Limited.—It has been resolved to wind up the company voluntarily; Mr. John Philip Spencer, 48, Collingwood Street, Newcastle-on-Tyne, is the liquidator.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company. Limited. The receipts for the month of July were £3,150, as compared with £3,003 in the corresponding month of last year. The receipts for the month of April, estimated at £3,600, realised £3,624.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of July were £2,016, against £1,677 in the corresponding period of last year.

The Great Northern Telegraph Company, Limited. The receipts for the month of July amounted to £25,000; 1st January—31st July, 1890, £158,000; corresponding months 1889, £154,200; do. 1888, £156,000.

The Western and Brazilian Telegraph Company. Limited. The receipts for the week ending August 1st, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3.921.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month of July, 1890, were £5,825.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (July 31).	Closing Quotation. (August 7.)	Business done during week ending August 7, 1890.	
					Highest.	Lowest.
£						
250,000	African Direct Telegraph, Ltd., 4 p. c. Deb. Regd. and to Bearer	100	97 —100	97 —100	98⅛	...
1,549,160	Anglo-American Telegraph, Limited	Stock	49½— 50½	49½— 50½xd	50	...
2,725,420	Do. do. 6 p. c. Preferred	Stock	85 — 86 xd	85 — 86 xd	86	85¼
2,725,420	Do. do. Deferred	Stock	13¾— 14¼xd	13½— 14	14⅛	13½
130,000	Brazilian Submarine Telegraph, Limited	10	11½— 12	11½— 12	18⅞	...
99,000	Do. do. 5 p. c. Bonds...	100	102 —104	100 —102 xd		
75,000	Do. do. 5 p. c. 2nd Series, repayable June, 1906	100	103 —107	103 —107		
63,416	Brush Electric Engineering Ordinary, Nos. 1 to 63,416... ...	3	1¾— 2	1½— 2	1¾	...
63,416	Do. do. Preference, Nos. 1 to 63,416 ...	2	1⅝— 1⅞	1½— 2	1⅞	...
$7,216,000	Commercial Cable, Capital Stock	$100	103 —105	103 —105	103¾	103½
224,850	Consolidated Telephone Construction and Maintenance, Ltd. ...	14/-	$\frac{9}{16}$— $\frac{11}{16}$	$\frac{9}{16}$— $\frac{11}{16}$	½	...
20,000	Crompton & Co., Limited, 7 p. c. Pref. Shares, Nos. 1 to 20,000	Stock	5¼— 5¾xd	5¼— 5¾xd		
16,000	Cuba Telegraph, Limited	10	12¾— 13¼	12¾— 13¼	12⅞	...
6,000	Do. do. 10 p. c. Preference	10	17 — 18	17 — 18	17⅞	17⅛
12,931	Direct Spanish Telegraph, Limited ... (£4 only paid)	5	3½— 4	3½— 4		
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10	9¾	...
60,710	Direct United States Cable, Limited, 1877	20	10⅛— 10⅜xd	10⅛— 10⅜xd	10⅜	...
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	13⅞— 14⅛xd	13⅞— 14⅛xd	14⅛	13⅞
70,000	Do. 6 p. c. Preference	10	15 — 15½xd	15 — 15½xd	15¼	15⅛
200,000	Do. 5 p. c. Debs. (1879 issue), repay. Aug., 1899	100	108 —111	106 —109 xd		
1,200,000	Do. 4 p. c. Mortgage Debenture Stock	Stock	106 —109	106 —109		
250,000	Eastern Extension, Australasia and China Telegraph, Limited	10	14 — 14¼	14 — 14¼	14¼	14
320,000	Do. 6 p. c. Debentures, repay. February, 1891	100	101 —103	100 —102 xd		
446,100	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. ...	100	103 —106	103 —106	103	...
12,500	Do. 5 p. c. Debentures, 1890, redeem. ann. drawings ...	100	103 —106	103 —106		
367,900	Eastern and South African Tel., Ltd., 5 p. c. Mort. Deb., 1900...	100	100 —103	100 —103	101¾	...
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	4¾— 5¼	4¾— 5¼		
46,700	Elmore's Patent Copper Depositing, Ltd., Nos. 23,001 to 70,000	2	4 — 4½xd	4¼— 4¾xd	4½	4⅛
19,700	Fowler-Waring Cables, Nos. 301 to 20,000 ...(£3 only paid)	5	2 — 2½	2 — 2½		
180,227	Globe Telegraph and Trust, Limited	10	8⅞— 9⅛	8⅞— 9⅛	9$\frac{1}{16}$	8$\frac{15}{16}$
180,042	Do. do. 6 p. c. Preference	10	14⅞— 15⅛	14⅞— 15⅛	14$\frac{15}{16}$	14⅞
150,000	Great Northern Tel. Company of Copenhagen	10	15¾— 16¼	15¾— 16¼	16⅛	15⅞
40,000	Do. do. 5 p. c. Debs. (issue of 1881) ...	100	100 —103	100 —103		
250,000	Do. do. do. (issue of 1883) ...	100	106 —109	106 —109		
9,334	Greenwood and Batley, Ltd., Ordinary, Nos. 4,667 to 14,000 ...	10	12 — 13	12 — 13		
5,334	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	11½— 12½	11½— 12½		
41,600	India-Rubber, Gutta-Percha and Telegraph Works, Limited ...	10	18½— 19½	18½— 19½		
200,000	Do. do. 4½ p. c. Deb., 1896...	100	102 —104	102 —104		
17,000	Indo-European Telegraph, Limited...	25	37 — 39	37 — 39	38½	38
38,348	London Platino-Brazilian Telegraph, Limited	10	6 — 7	6 — 7		
100,000	Do. do. do. 6 p. c. Debentures ...	100	107 —110	107 —110		
49,900	*Metropolitan Electric Supply, Limited, Nos. 6,101 to 50,000 ...	10	4 — 4½	4 — 4½		
436,700	National Telephone, Limited, Nos. 1 to 436,700	5	4¾— 5	4¾— 5	5	4⅞
15,000	Do. 6 p. c. Cum. 1st Preference	10	12¼— 12¾	12¼— 12¾	12½	...
15,000	Do. 6 p. c. Cum. 2nd Preference (£8 only paid)	10	10 — 10½	10 — 10½	10⅜	10⅛
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11/- only paid)	1	¼— ⅜	¼— ⅜		
9,000	Reuter's, Limited	8	7¾— 8¼	7¾— 8¼		
209,750	South of England Telephone, Ltd., Ordinary, Nos. 1 to 2,000, 2,501 to 3,500, 93,251 to 300,000	1	¼— ½xd	¼— ½xd		
20,000	Do. 6 p. c. Cum. Pref., Nos. 1 to 20,000 (£3½ only paid)	5	2½— 3 xd	2½— 3 xd		
3,381	Submarine Cables Trust	Cert.	112 —116	113 —117		
78,949	Swan United Electric Light, Limited ... (£3½ only paid)	5	5 — 5½	5 — 5½	5⅛	5$\frac{1}{16}$
37,350	Telegraph Construction and Maintenance, Limited	12	42 — 44	42 — 44	43¼	42
150,000	Do. do. do. 5 p. c. Bonds, red. 1894	100	100 —102	100 —102		
55,000	United River Plate Telephone, Limited	5	4 — 4½xd	4 — 4½xd		
146,000	Do. do. 5 p. c. Debenture Stock... ...	Stock	90 — 94	90 — 94		
100,000	Do. do. 7 p. c. Debs., Nos. 1 to 1,000 ...	100	... ...	... ...		
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	9 — 10	9 — 10		
300,000	Do. do. do. 5 p. c. Debentures	100	100 —103	100 —103	101¼	100⅝
30,000	West Coast of America Telegraph, Limited	10	5 — 6 xd	5 — 6 xd	5¼	...
150,000	Do. do. do. 8 p. c. Debs, repay. 1902 ...	100	106 —110	106 —110		
64,572	Western and Brazilian Telegraph, Limited	15	10 — 10½	10 — 10½	10¼	10
26,986	Do. do. do. 5 p. c. Cum. Preferred	7½	6½— 7	6½— 7		
26,986	Do. do. do. 5 p. c. Deferred	7½	3¾— 4¼	3¾— 4¼	4	...
200,000	Do. do. do. 6 p. c. Debentures "A," 1910...	100	106 —109	103 —106 xd	104½	103½
250,000	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	104 —107	101 —104 xd		
88,321	West India and Panama Telegraph, Limited	10	2½— 2¾	2¾— 3	2$\frac{15}{16}$	2⅞
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	11 — 11½	11¼— 11¾	11½	...
4,669	Do. do. do, 6 p. c. 2nd Preference ...	10	12½— 13½	12½— 13½		
1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mort (Building) Bonds	$1,000	120 —125	120 —125		
179,300	Do. do. 6 p. c. Sterling Bonds	100	99 —101	99 —101		
42,853	*Westmstr. Elec. Sup. Corp., Ord., Nos. 101 to 42,953 (£2 only paid)	5	1¼— 1¾	1¼— 1¾		

* Subject to Founders Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7⅛—7⅜.—Electric Construction Corporation (£10 paid), 7¾—8¼ Elmore Copper Depositing Priorities, 5¾—6¼.—Elmore Wire, ¼ dis—par.—House-to-House Company (£5 paid), 5 —5½.—London Electric Supply Corporation, Ordinary (£5 paid), 1¾—2.—Manchester Edison and Swan Company, £9, (£1 paid), 12/- —14/-.

Bank Rate of Discount.—5 per cent. (31st July, 1890).

MAGNETIC PROPERTIES OF ALLOYS OF NICKEL AND IRON.*

By J. HOPKINSON, D.Sc., F.R.S.

EIGHT different alloys have been examined. The methods of experiment were the same as were detailed in my paper on "Magnetic and other Physical Properties of Iron at a High Temperature." The dimensions of the samples were also the same.

A. The following is the analysis of this sample :—

Fe.	Ni.	C.	Mn.	S.	P.
97·96	0·97	0·42	0 58	0·03	0·04 per cent.

In this case a magnetisation curve is all that I have obtained free from doubt; the sample was heated and its magnetisation determined at various temperatures for a force of 0·50, but the higher temperatures must be taken as a shade doubtful, as the secondary broke down before cooling, and I cannot be sure whether or not the resistance of the secondary may have changed.

Table I gives the results at the ordinary temperature for the material before heating.

TABLE I.

Magnetising force.	Induction.
0·06	11
0·12	29
0·26	58
0·53	122
1·07	303
2·14	995
4·7	4,560
8 8	9,151
16 8	12,876
38·9	15,651
270·0	21,645

The only noteworthy features are that the coercive force is obviously somewhat considerable, and that the maximum induction is great—greater than that of the more nearly pure iron.

B. The following is the analysis of the sample :—

Fe.	Ni.	C.	Mn.	S.	P.	Si.
94·799	4·7	0·22	0 23	0·014	0·037	trace per cent.

We have here results of induction in terms of temperature for a magnetising force of 0·12. The experiment with rising temperature was made by simply observing with a watch the hour at which the temperature attained successive values whilst the piece was in the furnace; the cooling experiments were made in exactly the way described in "Phil. Trans." A, 1889, p. 463.

The most remarkable feature in this case is that the material has two critical temperatures, one at which it ceases to be magnetisable with increase of temperature, the other, and lower, at which it again becomes magnetisable as the temperatures fall, and that these temperatures differ by about 150° C. Between these temperatures, then, the material can exist in either of two states —a magnetisable and a non-magnetisable.

We may infer from the experiments that the latent heat liberated in cooling is about 150 times the heat liberated when the temperature of the material falls 1° C.

C. This alloy is very similar to the last; its analysis is :—

Fe.	Ni.	C.	Mn.	S.	P.
94·39	4·7	0 27	0·57	0·03	0·04 per cent.

In Table II. are given the results of observations of induction in terms of magnetising force at the ordinary temperature of the room.

TABLE II.

Magnetising Force.	Induction.
0 06	14
0 12	29
0·25	60
0 52	127
1·05	294
2·10	760
4·6	3,068
8·7	8,786
16 6	13,641
38·5	16,702
266·5	21,697

D. This sample contains 22 per cent. of nickel. It was not throughly tested, as the supply of CO_2 which happened to be available was insufficient. Its magnetic properties, however, were similar to the next sample.

E. The analysis of this sample was—

Fe.	Ni.	C.	Mn.	S.	P.	Si.
74·31	24·5	0·27	0·85	0·01	0·04	0 02 per cent.

As the material was given to me it was non-magnetisable at ordinary temperature; that is to say, the permeability was small, about 1·4, and the induction was precisely proportional to the magnetising force. The ring on being heated remained non-magnetisable up to 700° C. or 800° C. A block of the material did not recalesce on being heated to a high temperature and being allowed to cool.

On being placed in a freezing mixture, the material became magnetic at a temperature a little below freezing point.

The material was next cooled to a temperature of about – 51° C. by means of solid carbonic acid. After the temperature had returned to 13° C. the curve of magnetisation was ascertained; from this it appeared that the ring of the material which was previously non-magnetisable at 13° C. was now decidedly magnetisable at the same temperature. On heating the material it remained magnetisable until it reached a temperature of 580° C. At this temperature it became non-magnetisable, and, on cooling, remained non-magnetisable at the ordinary temperature of the room. The experiments showed that through a range of temperature from somewhat below freezing to 580° C., this material exists in two states, either being quite stable, the one being non-magnetisable, the other magnetisable. It changes from non-magnetisable to magnetisable if the temperature be reduced a little below freezing; the magnetisable state of the material does not change from magnetisable to non-magnetisable until the temperature is raised to 580° C.

The same kind of thing can be seen in a much less degree with ordinary steel. Over a small range this can exist in two states; but in changing its state from non-magnetisable to magnetisable a considerable amount of heat is liberated, which causes rise of temperature in the steel. It is observed in samples B and C of nickel steel, but at a higher temperature.

As might be expected, the other physical properties of this material change with its magnetic properties.

The wire as sent to me was magnetisable as tested by means of a magnet in the ordinary way. On heating it to a dull redness it become non-magnetisable, whether it was cooled slowly or exceedingly rapidly, by plunging it into cold water. A quantity of the wire was brought into the non-magnetisable state by heating it and allowing it to cool. The electric resistance of a portion of this wire, about 5 metres in length, was ascertained in terms of the temperature; it was first of all tried at the ordinary temperature, and then at temperatures up to 340° C. The wire was then cooled by means of solid carbonic acid. The wire was then allowed to return to the temperature of the room, and was subsequently heated; the heating was continued to a temperature of 680° C., and the metal was then allowed to cool. From this it appeared that in the two states of the metal (magnetisable and non-magnetisable) the resistances at ordinary temperatures are quite different. The specific resistance in the magnetisable condition is about 0·000052; in the non-magnetisable condition it is about 0 000072. The curve of resistance in terms of the temperature of the material in the magnetisable condition has a close resemblance to that of soft iron, excepting that the coefficient of variation is much smaller, as, indeed, one would expect in the case of an alloy; at 20° C. the coefficient is about 0·00132; just below 600° C. it is about 0·0040, and above 600° C. it has fallen to a value less than that which it had at 20° C. The change in electrical resistance effected by cooling is almost as remarkable as the change in the magnetic properties.

Samples of the wire were next tested in Prof. Kennedy's laboratory for mechanical strength. Five samples of the wire were taken which had been heated and were in the non-magnetisable state, and five which had been cooled and were in the magnetisable state. There was a marked difference in the hardness of these two samples; the non-magnetisable was extremely soft, and the magnetisable tolerably hard. Of the five non-magnetisable samples, the highest breaking stress was 50·52 tons per square inch, the lowest 48·75; the greatest extension was 33 per cent., the lowest 30 per cent. Of the magnetisable samples, the highest breaking stress was 88·12 tons per square inch, the lowest 85·76; the highest extension was 8·33, the lowest 6·70. The broken fragments, both of the wire which had originally been magnetisable and that which had been non-magnetisable, were now found to be magnetisable. If this material could be produced at a lower cost, these facts would have a very important bearing. As a mild steel, the non-magnetisable material is very fine, having so high a breaking stress for so great an elongation at rupture. Suppose it were used for any purpose for which a mild steel is suitable on account of this considerable elongation at rupture, if exposed to a sharp frost its properties would be completely changed—it would become essentially a hard steel, and it would remain a hard steel until it had actually been heated to a temperature of 600° C.

F. This sample contains 30 per cent. of nickel.

The remarkable feature in this case is the low temperature at which the change between magnetisable and non-magnetisable occurs, whether the temperature is rising or falling. Comparing it with the last sample, the character of the material with regard to magnetism is entirely changed.

G. The analysis of this sample is :—

Fe.	Ni.	C.	Mm.	S.	P.
66·19	33·0	0·28	0 50	0·01	0 02 per cent.

The remarkable feature of this material is the complete difference from the last but one, and the low temperature of change. There is but very little difference between the temperature of change when heated and when cooled.

H. The analysis of this sample is :—

Fe.	Ni.	C.	Mn.	S.	P.
26·50	73·0	0·18	0 30	0·01	0·01 per cent.

It is curious to remark that with this material the induction for considerable forces is greater than in the steel with 33 per cent. of nickel; and that it is greater than for a mechanical mixture of iron and nickel in the proportions of the analysis, however the particles might be arranged in relation to each other.

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* Abstract from Proceedings of the Royal Society.

The critical temperature of the material is 600° C.; it shows no material difference between the critical temperatures for increasing and diminishing temperatures.

LIFE AND EFFICIENCY OF ARC LIGHT CARBONS.*

SINCE the earlier stages of arc lighting little or no increase in the efficiency of the carbon points appears to have been made. Now that the dynamo machines and lamps have reached such a state of perfection, the subject presents itself as pre-eminently important. The arc light pencil, considered as an individual part of the system, is indeed a small thing, but in it undoubtedly lies the weak spot of the system. With a view of studying the action of modern carbon pencils, the investigations herein described were undertaken. The carbons experimented upon were all of American manufacture, and were procured from five companies (A, B, C, D, E).

While the greater part of the research was upon the life and efficiency of the pencils, observations were also made in other directions.

The subject was treated under the following heads:—

1. Structure of the carbons.
2. Life tests.
3. Efficiencies.
4. Candle-power measurements.
5. Observations of the arc and carbon points.

1.—STRUCTURE OF THE CARBONS.

It is well known that the life and efficiency of a carbon depends upon the system in which the carbon is burned. For instance, the requirements of the low tension system seems to be a carbon that is hard, well plated and a good conductor, the latter being the most important. In the high tension system, on the contrary, hardness and conductivity seem to be of secondary importance. There is a tendency to "flame" and burn unsteadily when a hard carbon is used in this system, and a softer one sometimes becomes necessary.

It is interesting to note the methods employed by carbon manufacturers to attain the conditions above mentioned. In one of the largest carbon works, "forced" carbons, or those made by "squirting" the plastic material through a die, are manufactured for both high and low tension systems of lighting, to the exclusion of moulded pencils. On the other hand, another company makes no forced carbons, but claims that its moulded carbons are superior for either system. The classification given below shows the types of carbons now upon the markets for both systems.

Thin tranverse sections of all the specimens were cut and mounted on glass slides, and a microscopical examination made.

Carbon.	High tension.	Low tension.
A	(1) moulded	(2) forced
B	(3) ,,	(4) moulded
C	(5) ,,	(6) ,,
D	(7), (8) forced	(8), (9) forced
E	(10) moulded (11) forced	(12) ,,

On examination a marked difference is seen between the structure of a moulded and a forced carbon. In the high tension pencil (1) the structure is a loose one, while the low tension rod (2) is marked by a dense and homogeneous structure; the size of the grains of carbon in the latter case is much less than in the former, and the particles have a more metalloid lustre. There is probably considerable air space in (1). The two rods thus have respectively the qualifications stated above required for high and low tension pencils. The resistance of (1) was found to be ·199 ohm; (2) ·144 ohm; while (2) plated was ·084 ohm.

In class B, (3) and (4) were of similar structure, and the resistance was varied by the thickness of the copper plating.

In class C (5) and (6), both moulded carbons, the structure varies owing to a far higher pressure being employed in moulding the low tension rods.

In group D, besides a difference in pressure during manufacture, there is also a difference in the "mix" or composition of the carbon; (8) is an attempt to construct a carbon suitable for either high or low tension and is a mean between (7) and (9).

In group E, there is great dissimilarity between (10) and (11) although used for the same purpose; (11) being very similar in structure to (9) D, but containing less pure carbon. The efficiency of these types will be discussed further on.

2.—LIFE TESTS.

If a carbon is burned with a small current its life will be long, at a sacrifice of light-giving properties. If, on the other hand, a large current is used, there may be a gain in efficiency at a sacrifice of life. The question arises—what is the proper current to use. Of course circumstances determine to a large extent the answer, and generally such a current is used as gives a fair mortality at a reasonable efficiency of the carbon.

The high tension carbons submitted for test were designed to be burned at about 10 ampères, and the low tension at about 20 ampères. In the life tests a Thomson lamp was used for the high tension runs, current being constantly kept at 10 ampères and P.D. at 50 volts. For low tension carbons a Weston lamp was used. The pencils were accurately weighed before and after the runs, and the life calculated on the assumption that the carbons were homogeneous. Each set of pencils were burned an hour. It has been stated that "with carbons of the same *hardness* and length, but having different diameters, the larger will undoubtedly outlive the smaller. Of carbons of the same *diameter* and length, but differing in hardness, the harder will outlive the softer." This statement presupposes that the conductivity of the carbon is directly dependent on the hardness or softness of the pencil. In order to examine more fully the relation between diameter, resistance and mortality of a pencil, six sets of carbons of the brand B, varying in diameter from ½ to 1⅕th inches were carefully weighed, their resistances measured by the Wheatstone bridge method, and the pencils burned with a constant current of 10 ampères, the P.D. at the terminals of the lamp being kept at 50 volts. The diameters and resistances respectively of the upper and lower carbons were in each case practically the same. A mean of 10 micrometer measurements of the diameter was taken as correct. The duration of each run was 60 minutes.

From the results obtained it appears that the life of a carbon varies *directly* with its *diameter* and *inversely* with its *resistance.* This law holds good only for homogeneous carbons of the same manufacture, type, and structure, and as stated previously, for constant current and voltage.

Taking the ½ inch (·505 inch) and 1 inch (·986 inch) pencils as standards and from the relation above stated, calculate the mortality of the other carbons.

The table gives a comparison between the actual and the calculated life of the specimens tested.

TABLE.

Carbon.	Mean diameter in inches.	Standard ½ inch (·505)	Standard 1 inch.	Actual life hours.
		Calculated life hours.	Calculated life hours.	
B moulded light	·453	10·92	9 32	10·64
,, ,,	·618	15·10	13·62	13·64
,, ,,	·739	21·58	19·44	21·38
,, ,,	1·195	36·40	33·04	33·49

Thus it appears that the calculated life is larger than the actual when the half-inch carbon is taken as a standard, and smaller when the 1 inch pencil is made the basis of calculation. Every precaution is taken to avoid discrepancies, but errors are apt to creep into the work. The results, however, without doubt, point to the existence of such a law as has been quoted.

Next, experiments were made to determine the curve for current and mortality of the pencil, when the voltage is kept constant. The range of current was from 6 to 13 ampères, and greatest variation in tension was one volt.

Another series of tests was made with constant currents and varying voltage. The current being kept at 10 ampères, and the range in tension was from 40 to 60 volts. In these tests the consumption of carbon was taken for both pencils + and −.

Very little has been published relative to the life of the plus and minus carbons; Munro and Jamieson state that, "with continuous currents the plus wastes twice as fast as the minus carbons. With alternating currents the upper wastes 8 per cent. faster than the lower if the carbons are vertical, but at the same rate if horizontal." The accompanying table shows the result of our tests on this point.

TABLE.—RELATIVE LIFE OF THE PLUS AND MINUS CARBONS

Carbon.	Current in ampères.	E.M.F. volts.	Time of run in mins.	Loss + grms.	Loss − grms.	Life 1 in. − / Life 1 in. +
B moulded high ten.	10	50	60	5·28	4·40	1·20
B ,, low ten.	10	50	60	5·14	3·27	1·57
A ,, high ten.	10	50	60	5 98	3·20	1·87
E forced low ten.	22½	28	150	193·18	74 42	2·59
B molded low ten.	22½	28	150	166 60	51·50	3·23
C ,, ,, ,,	22½	28	145	151·00	41·00	3·68

From this table it can be seen that the + and − carbons may burn away fairly in equal proportions, or may waste in the plus carbon more than three and a half times as quickly as the minus carbon.

For determining the influence of diameter and resistance upon the relative life of the plus and minus carbons, a number of moulded high tension carbons, A brand, were used, taken from the same batch, and burned with a current of 10 ampères and a voltage of 50. The experiments seem to show that $\left\{\frac{\text{life} -}{\text{life} +}\right\}$ appears to become greater with increase of diameter of carbon; but probably the inequality in the diameters of the + and − pencils respectively, as well as the difference of resistance of the two carbons of a set, explains the increase in the ratio. For assuming that under the conditions the life of a carbon varies directly with its diameter and inversely as its resistance, this is an indication that if the diameters and resistances respectively of the + and − carbons were the same in each run, the ratio would be practically the same for all sizes of carbons.

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* Abstract of paper read by Louis B. Marks before the American Institute of Electrical Engineers, Boston.

The experiment with change of current and constant potential shows that the change of current, other things being constant, produces very little effect on the ratio $\left\{\frac{\text{life} -}{\text{life} +}\right\}$.

On the other hand, when potential differs and current is constant, the higher the potential the nearer the approach to unity is obtained in the ratio.

The relative life of carbons of the same diameter is influenced chiefly by the difference in the resistance of the carbons and the variations of the P.D.

It was conjectured that blowing the arc during a run with a magnet would increase the life of the + carbon; the reverse was found to be the case, but with little effect on the − carbon.

EFFICIENCY.

Two methods of determining the efficiency of each set of pencils were employed. The first was the method used by Mr. Merritt in obtaining the efficiency of the incandescent lamp, and subsequently by Mr. Nakano in his work on the efficiency of the arc lamp. By this method the deflection of a galvanometer was taken as a measure of the energy of the total radiation falling upon the face of a thermopile, the dark leats being cut off by passing the rays through an alum cell. The second method dealt with candle-powers obtained by photometric measurements. Mechanism was employed whereby the angle of radiation from the arc could be altered without altering the distance of the centre of the arc from the thermopile. In the results it was noticed that the horizontal efficiency is very small compared with the maximum; that relatively high efficiency in a *forced high tension* carbon is obtained only at the expense of life; that a *moulded* carbon is, generally speaking, superior to a *forced* for high tension and *vice versâ* for low tension. In the case of the high tension carbons of brand B and D, of smaller diameter than that of the other pencils, we have a relatively higher efficiency, it was shown last year that the efficiency varies inversely as the diameter. A copper-plated carbon lasts longer than a naked one, but the mean sphericity appears to be the same for both, or but very slightly in favour of the coated carbon. The use of the plating prevents *disintegration,* and so prolongs the life of the pencil; the actual amount of *combustion* is apparently the same in either case.

The conclusions drawn from the series of candle-power tests show that the efficiency of low tension carbons, and especially of *moulded* low tension carbons, is comparatively small; while the efficiencies of *moulded* high tension carbons are as high as 783 to 840 candles per electric horse-power expended in the lamp; low tension pencils of the same diameter nearly give only 594 to 502 candles per electric horse-power.

M. Gérard's formula, for the mean spherical candle-power of a lamp, is of sufficient exactitude for practical purpose.

Spherical C.P. = $\frac{1}{2}$ horizontal C.P. + $\frac{1}{4}$ maximum C.P. The average error is only about 5 per cent., and is most generally correct as an approximation. For the total radiation where the efficiency depends upon the ratio $\left\{\frac{\text{luminous radiation}}{\text{total radiation.}}\right\}$ Gérard's law does not hold, but for approximations spherical efficiency = $\frac{1}{4}$ horizontal + $\frac{3}{4}$ maximum.

OBSERVATIONS OF THE ARC AND THE CARBON POINTS.

With a given potential difference between the terminals of the lamp, the length of the arc depends upon the current flowing, and increased as the current becomes greater. If the current be constant, the length of arc increases with the P.D. Examining the carbons after burning at varying currents and constant P.D., it was seen that with 5 ampères there was a tendency to form a "mushroom" on the lower or negative carbon; the latter is eaten away considerably just below the tip. With 10 ampères it is less, and at 15 ampères hardly perceptible. The plus carbon has a variable diameter of crater, increasing with the strength of the current, but with a greater depth with the lower currents. With high currents the carbon is disintegrated to a greater distance above the points than with low. With constant current and increasing potential, the shape of the carbons change from a point at 40 volts to a blunt end at 60 volts. The mushroom that forms where the carbon is burned with low current and high voltage, is absent at high current and low voltage. At 60 volts the crater had disappeared, and the carbons flamed; below a certain voltage for every make of carbon there is a point when *hissing* commences.

At too high a voltage the crater breaks away and flaming begins. Soft cored carbons somewhat remedy this defect and should not flame at all at the proper voltage for the particular make. The breaking off of the small mushroom button on the negative carbons is invariable accompanied by *hissing.*

The remedy for irregularities in the burning of arc lamps lies with the carbon manufacturer.

In the present state of the art of carbon manufacture, a careful discrimination in selecting carbons should be urged on all central station managers; as recently a comparative test of the best known carbons in the market carried out by Mr. G. F. Peck, of Brooklyn, resulted in a saving of 64·73 electrical horse-power in a station burning a thousand lamps.

PROCEEDINGS OF SOCIETIES.

The Institution of Electrical Engineers.

"The Working Efficiency of Secondary Cells." By W. E. AYRTON; C. G. LAMB, E. W. SMITH and M. W. WOODS, Associates. Read at Edinburgh, Wednesday, July 16th.

(*Concluded from page* 140.)

These two conditions, however, we have fulfilled by the employment of the following device, by means of which the difference between the values of V and of E was measured to the one-thousandth of a volt at identically the same moment that the values of V and A were measured. The process was as follows:—

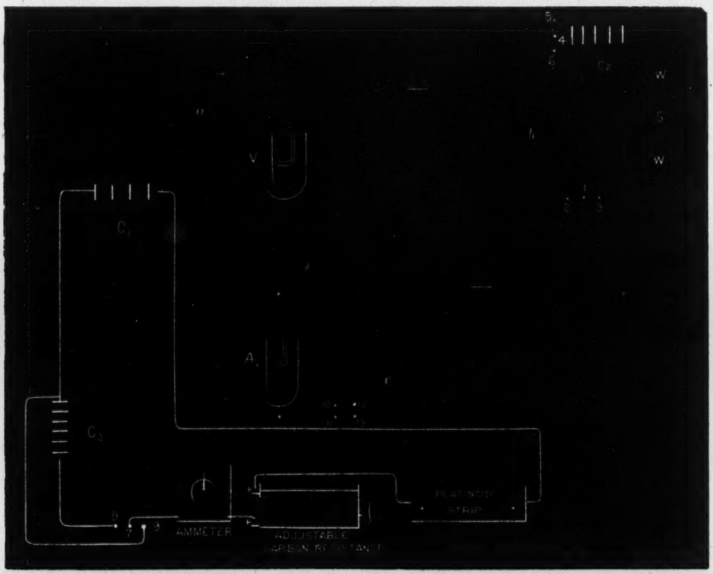


FIG. 10.—APPARATUS FOR MEASURING THE RESISTANCE OF THE ACCUMULATORS C_1.

1. The sensibility of the voltmeter was adjusted so that 12 volts produced a deflection of 600 divisions, and V, the P.D. at the terminals of the four accumulators under test, was measured.
2. A compensating E.M.F. was introduced into the circuit just sufficient to bring the spot of light to zero.

3. The sensibility of the voltmeter was increased 60 times.

4. The main circuit was broken, and the time variation of E, the E.M.F. of the accumulators under test, observed by noting the position of the spot of light at the successive ticks of a metronome, whose rate of going was before each experiment carefully adjusted by comparing the metronome with a chronometer.

5. A time curve for the values of E was drawn, and by producing it back until it cut the line passing through time nought—that is, the time when the main circuit was broken—we obtained the value of E at the same moment that the values of V and A were measured.

The apparatus employed is symbolically shown in fig. 10. C_1 are the four accumulators under test; when they were being charged by means of the accumulators C_2, a bridge-piece was placed so as to join the mercury cups 7 and 8; whereas, when C_1 were being discharged, mercury cup 7 was joined to 9 instead of to 8. In both cases the current passed along the thick lines through an A. and P. magnifying spring ammeter, whose indications furnished an approximate measure of the current, through an adjustable carbon resistance and a platinoid strip which could carry the maximum current, 10 ampères, used in these tests, without its resistance being perceptibly altered. To two points of this strip were soldered two wires going to the mercury cups 10 and 13; these were joined respectively to 11 and 12 in charging, and to 12 and 11 in discharging, so that the current always went through the D'Arsonval galvanometer, A, in the same direction. This galvanometer then measured the charging or discharging current, its sensibility being such that for a current of 9 ampères passing through the circuit a deflection of 600 scale divisions was produced when the resistance in *d* was 185 ohms, that of the galvanometer A itself being 52 ohms.

By joining the mercury cups 1 and 2 with a bridge-piece, the P.D. between the terminals of the accumulators under test, C_1 could be measured with the voltmeter, V; the sensibility being such that with a resistance of 791 ohms in *a*, and 63,696 ohms in *b*, a deflection of 600 scale divisions corresponded with a P.D. of 12 volts. By connecting the mercury cup 1 with 3 instead of with 2, the resistance, *b*, was cut out of the circuit, and the sensibility of the voltmeter, V, was increased 60 times. If now 4 were connected with 5 or with 6, and the sliding contact, S, moved along the thick wire. W, W, a point could be found such that no current passed through the voltmeter, V. Next, the main circuit indicated by the thick wires was broken, when the spot of light would move quickly across a portion of the scale, and then continue moving right across the rest of the scale. The first part of this motion was of course due to the sudden variation of the P.D. at the terminals of the accumulators, C_1, on the current through them being stopped, while the continuation of the motion was due to the subsequent variation of the E.M.F. of these accumulators after the current was stopped. And the value of the E.M.F. at any moment was equal to

$$V \pm \frac{0{\cdot}2\,d}{600},$$

where *d* was the deflection of the voltmeter spot of light at the moment in question, and V was the P.D. between the terminals of the cells, C_1, just before the main circuit was broken, and which was measured by the voltmeter deflection when mercury cup 1 was connected with 2. In discharging the + sign was, of course, used, and in charging the − sign.

This P.D. at the terminals of the four accumulators under test, C_1, and which had to be balanced by the E.M.F. of the accumulators, C_2, approached 9·6 volts towards the end of a charge, while it fell to 7·6 volts at the end of a discharge. In the former case the E.M.F. of four cells and a portion of the fifth of the compensating accumulators, C_2, was employed, while in the latter the E.M.F. of three and a portion of the fourth sufficed. Hence, during the charge mercury cups 4 and 5 were connected together, while during the discharge it was 4 and 6 that were connected together. The portion of the E.M.F. of the last of the compensating cells was, as shown in the figure, obtained by shunting this cell through a platinoid wire, W W, of about 2 ohms resistance, and making contact with a point of this wire farther from, or nearer to, the positive pole of this cell. This adjustment of the position of S caused very little change in the resistance of the voltmeter circuit, because the resistance of W W, was but a small portion of the entire resistance in the voltmeter circuit.

This method of measuring the resistance of accumulators was applied by three of the students of the Central Institution—Messrs. Müller, Stephens, and Wightman—to determine the variation of the resistance during the entire discharge of the cells with 10 ampères, and charge with 9; further, during May and June of this year Mr. Müller has, with great perseverance, been making an uninterrupted series of observations, day and night, to determine the resistance during the entire discharge and charge for various currents. For each of these currents the cells are being brought to a steady working state by many discharges and charges being successively and without interruption made with each current. In the case of the small current the time of a charge and discharge is tediously long, the charge, for example, with 3 ampères requiring 40 hours to raise the P.D. from 1·9 to 2·4 volts per cell, so that several weeks have to be spent obtaining the resistance for this current. This investigation of resistance is not yet completed, and therefore we do not propose in this paper to refer to the variation of the resistsnce of a cell with different currents when the cell is brought to a *steady working state for each current*. Such an experiment has not, as far as we are aware, ever before been attempted with accumulators former observers having contented themselves with merely observing the variation of the resistance when the current during discharge or charge was abruptly changed from one value to another. This is a very different thing from ascertaining how the resistance of an accumulator varies with the current when *each* of the different currents employed is steadily used for some weeks in the discharging and charging of the cell, until the cell has arrived at a steady working state for the current in question.

We give in fig. 11 an example of the time fall of the E.M.F. on breaking the circuit for eight periods of 20 seconds during the charge. The curves are all drawn to the same scale, but, in order to get the curves into a reasonable space, a different zero line has been employed in drawing each curve. The actual E.M.F. in volts per cell is given for several points on each curve, so that the time rise at any period of the charge can be easily seen. The E.M.F. at the moment of breaking the circuit in each case is, as already explained, obtained by seeing at what point the curve cuts the vertical line through the time 0. The value of this point in volts is, in fact, what an infinitely dead-beat voltmeter would indicate immediately after the circuit was broken.

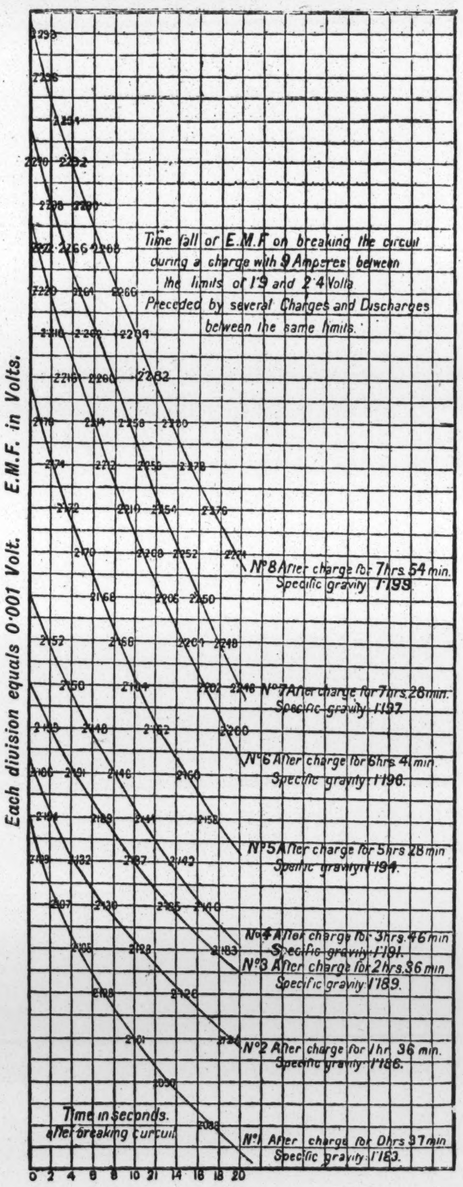


FIG. 11.

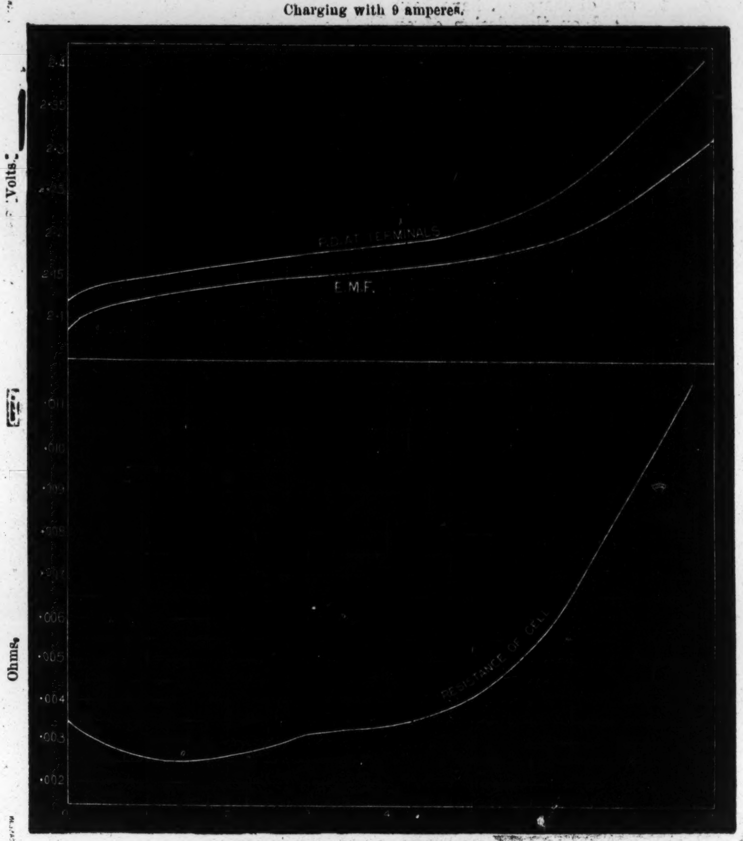
It will be observed that the time fall of E.M.F. on breaking the circuit becomes more and more rapid as the charge continues.

The top curve in fig. 12 gives the P.D. at the terminals of one accumulator, charging with 9 ampères; while the second curve gives the *simultaneous* values of the E.M.F., being, in fact, the curve drawn through points whose abscissæ are the times—0 hours 37 min., 1 hour 36 min., &c.—for which the eight curves on fig. 11 are drawn, and whose ordinates are the values of the points where these curves cut the vertical line drawn through the zero of time in fig. 11, or time when the charging circuit was broken. The lowest curve on fig. 12 gives the resistance of the cell at any moment during the entire charge with 9 ampères, the ordinates of this curve being calculated from the formula

$$\frac{V - E}{9},$$

where V and E are values of the P.D. and the E.M.F. of the cell at the same instant.

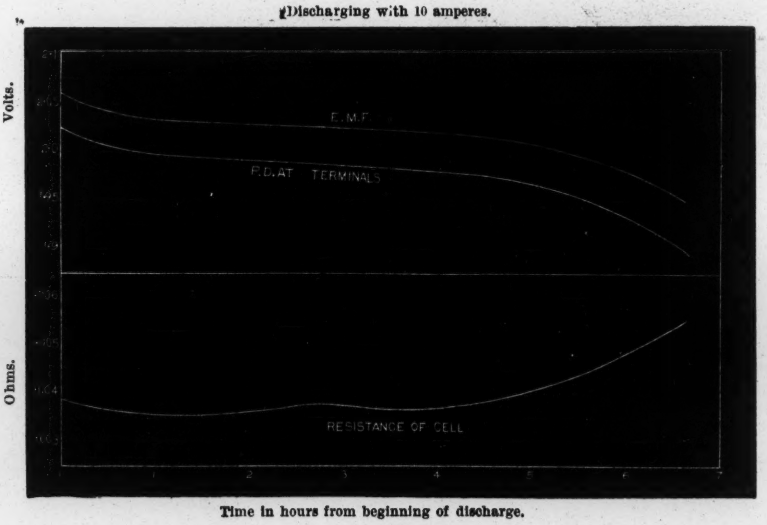
Charging with 9 amperes.



Time in hours from beginning of charge.

FIG. 12.

Discharging with 10 amperes.



Time in hours from beginning of discharge.

FIG. 13.

As the charging proceeds the resistance of the accumulator at first falls, and reaches a minimum; it then increases, at first slowly, but as the charging approaches the finish the resistance rises very rapidly, so that when the P.D. per cell is 2·4 volts the resistance is five times as great as its minimum value, which is reached shortly after the commencement of the charging. Taking 0·045 ohm as the average resistance during charging, and remembering that there are in these cells two positive plates each surface of which is 9¼ into 9¼ inches, and that all four surfaces are equally active, it follows that the mean resistance of the 1888 E.P.S. type of cell while charging with the maximum current-density allowed—viz., 3·787 ampères per square foot—is about 0·11 ohm per square foot of positive plate.

Fig. 13 gives the P.D. at the terminals of one of the cells during the whole of a discharge with 10 ampères, the simultaneous values of the E.M.F and of the resistance. The resistance at the commencement of the discharge is a little higher than at the commencement of the charge, and the minimum value to which it diminishes is not as low as the minimum attained by the resistance in charging. At the end of the fifth hour of discharge and charge the resistance is practically the same. After that however, there is a marked difference: the resistance in discharging does not rise as rapidly as in charging; and hence, since, in addition, the time of a discharge is necessarily less than of a charge, the resistance never reaches as high a value in discharging as in charging.

If we take 0·038 ohm as the mean resistance during a discharge with 10 ampères, then it follows that the mean resistance of the 1888 E.P.S. type of cell while discharging with the maximum current-density allowed—viz., 4·208 ampères per square foot—is about 0·09 ohm per square foot of positive plate.

Both in charging and in discharging with constant currents, the greater part of the time variation of the P.D. at the terminals of an accumulator is due to an actual variation in the E.M.F. itself; and it is only towards the end of the charge and of the discharge, when the resistance of the cell becomes relatively large, that the slope of the P.D. curve becomes practically different from that of the E.M.F. curve.

We may mention, in conclusion, that the results which we have obtained with accumulators made to go for long periods through definite cycles in charging and discharging, have been so interesting that we are now engaged on the design of an apparatus which will automatically keep the current constant for any time at any pre-arranged value, which will automatically change over from charge to discharge, or from discharge to charge, when the P.D. per cell reaches any pre-arranged limit, and which will record the P.D. at the terminals of the cell, and also its E.M.F. during the whole period.

We hope, therefore, at some future period to be able to present a graphical record of the life-history of accumulators from their first formation to their death.

"On Some Experiments in Radiometry."* Paper read by A. R. BENNETT, Member.

In the course of some experiments with radiometers, the author has been able to detect effects which are of interest, and which, if observed before, have not been published, so far as he is aware.

Some of the experiments detailed may not bear any apparent relation to electricity; but the fact that electrical vibrations and those which give rise to heat and light, are now admitted to be but different phases of the same phenomenon, must be the author's excuse for troubling the Institution with them.

Rotations of the vanes of ordinary radiometers can readily be produced by electricity.

An unusually sensitive radiometer placed between the poles of an influence machine (fig. 1) has its vanes strongly affected. As a rule, oscillation to and fro only is set up, but this may readily be converted into rotation by timing the impulses from the machine to the swinging of the vane, or by giving the vane an initial start by lighting a match, or jerking it. Then rotation continues so long as the machine is worked. Generally, but not invariably, the motion, if not started mechanically in the reverse, is in the same direction as would be produced by heat. After the machine stops, the vane continues to rotate for a time, even after the knobs of the machine are brought together; and when it is stopped, a single impulse is sufficient to set it off again. In the dark the bulb appears filled with the usual phosphorescent light.

The effect appears at least partly electroscopic, since, on starting, the nearest vane is usually attracted toward, and then repelled from, the knob.

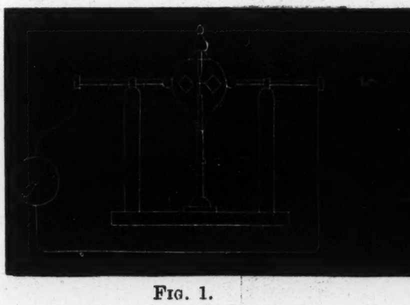


FIG. 1.

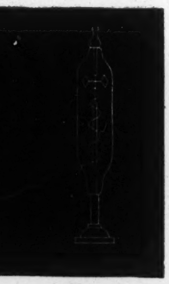


FIG. 2.

Placed against one pole only of the machine the vane oscillates feebly, but can be nursed into rotation.

With radiometers of special make more marked effects can be obtained. Several instruments having vanes fitted with metal caps, working on pivots connected to the outer air by wires fused in the glass were prepared (fig. 2).

Such radiometers really form condensers or Leyden jars, having the inner coating—the vane—free to move. The dielectric is the rarefied air, and the glass the outer coating.

When the vane is connected to one pole of an influence machine, rotates until the condenser, of which it forms a part, is fully charged, and then stops; when the current is arrested, the vane rotates again in the same direction, until the greater part of the charge has been lost. So, by timing the impulses from the machine, continuous rotation can be produced. In the four-vaned instrument on the table the motion produced is in the reverse direction to that due to heat, the black being seemingly attracted; but in that instrument the vanes are bent at an angle which would naturally render the impulses effective in the direction indicated. In the two-vaned instrument also shown the vanes have no bias, and the motion is sometimes in the one direction and sometimes in the other. This charge and discharge effect is produced feebly when the instrument is standing in the air, the vane only being connected to the machine. When the glass is brought near to or touches the opposite pole, it becomes more pronounced; and when the glass is coated with tinfoil and put in contact with the opposite pole, it becomes strong and invariable. If the foil is removed out of actual contact, but retained within free sparking distance, the vane no longer has periodic dead points, but discharges constantly to the outer coating, and rotation continues so long as the machine is worked. The process may be reversed by connecting one pole to the foil, and drawing the sparks from the vane by means of its connecting wire. The direction of rotation continues, however, as before. If the end of the vane wire be of small gauge—No. 40, for instance—it vibrates violently while discharging and with such rapidity that it seems double-ended, two perfect, and, apparently motionless, images of the ends appearing half an inch or more apart.

Continuous rotation may likewise be attained by means of an automatic discharger consisting of a strip of foil hanging from the outer coating of the radiometer opposite a contact point, which may be earthed or connected to opposite pole of machine (fig. 3). The foil diverges from the glass when the condenser gets charged up, and, making contact with the point, is discharged and falls back, only to be again repelled. (Experiment shown.) By this means the condenser is automatically prevented from becoming full, and the vane rotates so long as it is supplied with electricity from the machine. Conversely, the foil may be charged and the make-and-break performed by means of a light wire attached to the vane connection.

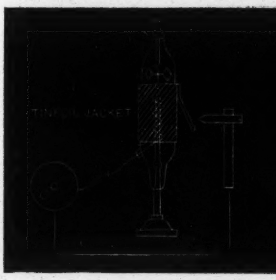


FIG. 3.

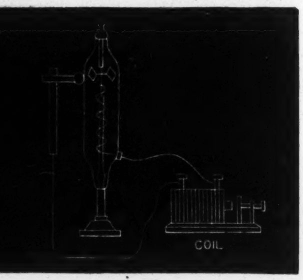


FIG. 4.

The radiometer with only one arm and two vanes is extremely sensitive, and exhibits the foregoing condenser effects in a marked degree. While charging or discharging it revolves with such rapidity as to make the arm appear a circle; and when fitted with an automatic discharger, each secondary discharge after the main one has been effected is accentuated by a kick. The rotation in this case is right and left indifferently, apparently according to the direction in which it first obtains an impulse. (Experiments with this instrument were shown after the paper.)

Experiments were made with these radiometers with the current from a Rhumkorff coil.

Placed between points or knobs connected to the secondary of the coil, an ordinary radiometer could be got to rotate if an initial jerk were given, either to left or right. Left to itself, it oscillated only, the tips of the vanes being alternately attracted towards the knob and repelled from it.

With a special radiometer connected as in fig. 4, oscillation only could be got with dry glass; but on wetting the circumference of the tube round the vane, rotation was immediately set up in the reverse direction to that caused by heat, and continued until the glass dried. Merely breathing on the glass caused rotation to recommence. The effect cannot be wholly due to the fact that the moisture made a conducting ring round the glass, as a band of tinfoil had no result unless wetted on the outside, when very feeble rotation began.

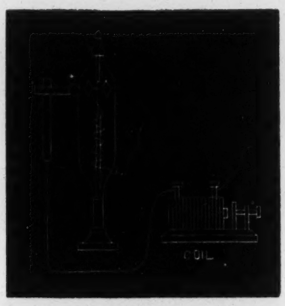


FIG. 5.

Rotation also occurred with wetted glass with connections as in fig. 5, the vane and one end of the coil being insulated.

In these induction coil experiments the silver side of the vane seemed uniformly repelled and the black attracted.

All the foregoing experiments exhibit beautiful luminous effects when viewed in the dark. Streams of phosphorescent light pass between the vanes, especially their edges, and the glass. The two-vaned instrument may be made to rotate by connecting one terminal of the coil to the vane and holding the other in one hand; two fingers (wetted) of the other hand being placed on opposite sides of the glass, rather under the level of the vane. The formation and disappearance of the lines of force between the wet finger tips and the edges of the vanes as they alternately approach and recede, then become vividly apparent.

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* Paper read at the special meeting of the Institution of Electrical Engineers at the Edinburgh International Exhibition, July 17th, 1890.

Radiometers of this construction being really Leyden jars, a good deal depends on the glass of which the instruments are made. A radiometer made of a different glass from those now before you exhibited rotation freely with coil when dry, although wetting increased the effect. With that instrument an air-space of one-eighth of an inch could be interposed between the knob and the glass without stopping the movement; and making the connection with the glass by means of a wetted finger quickened the rotation.

But the author, wishing to discover how far the effects were due to the rarefied air, broke the glass. It was found that the movements continued for a time after air was admitted, but ceased as soon as the inside of the tube became damp.

But the moment the tube was broken it became apparent that the vane was subject to new influences, and was even more sensitive in responding to them than it had been to heat or electricity whilst still in its prison of rarefied air.

Poised in the open air, it became an indicator of the utmost delicacy of air currents set up or altered in direction by the approach or movement of heated bodies. When placed in a quiet room, free from draughts, the movement of the person from one place to another, however slowly and carefully it might be managed, was sufficient to set the vane in motion. The approach of the body close to the vane—softly, so as to avoid the mechanical creation of draught—would agitate it powerfully, and frequently rotation for several seconds would be set up.

Experiments were tried with vanes of various substances, with and without lamp-black, but the rotation seems altogether independent of the character of the vane. Anything very light will do, and paper does as well as talc or aluminium.

When the light of the sun or of a lamp, or the heat of a kettle is made to fall on one side of the vane only, continuous rotation towards the light or heat is set up. In a dark room, without a fire, the light from a lamp was made to shine through a funnel of small diameter (fig. 6), so that one side of one of the fans only was illuminated at the time. After some hesitation and preliminary oscillation the fan invariably advanced towards the light, and continued to rotate in that direction so long as the persons in the room kept 12 or 14 feet away, remained quiet, and refrained from changing their positions. The movement of a person only 3 or 4 feet, however cautiously, would cause the vane to hesitate and stop for a moment or two, and the crossing of the room always violently disturbed the vane, sometimes causing the rotation to be reversed for a time. But when the body was kept stationary in its new position the old rotation toward the light recommenced, and continued until again disturbed.

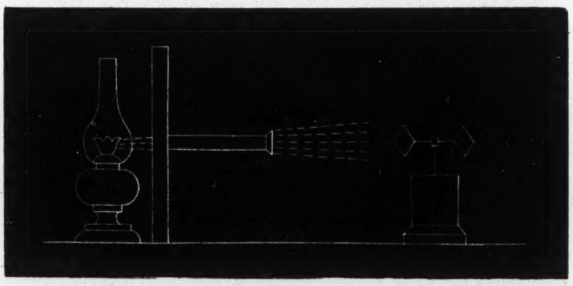

FIG. 6.

This, and the facts that rotation is set up, and motion already existing is arrested, by the mere proximity of the person, seem to indicate that every living body and every object of a temperature higher than the surrounding air constitutes a field of force. It heats and rarefies the air around it, which ascends under pressure of the heavier and colder outer air. Every person not in the vicinity of bodies as warm, or warmer than himself, is a centre towards which air is always advancing from all directions, and on every plane from his feet to his head. On reaching him it is heated and ascends, so that he is surrounded by a column of air, warmer and lighter than the general mass, and always in motion upwards. The light and delicately balanced vane is sensitive enough to reveal the presence of the resulting horizontal air currents. This is probably the explanation of the experiment shown in fig. 6. The side of the fan facing the lamp, radiating the heat it receives, rarefies the air in front of it, which ascending, the fan is forced forward by the greater pressure of the colder air behind it. Each fan in turn, as it comes under the ray of heat, is subjected to the same influence, and so rotation is attained towards the lamp.

The movement of a body from one part of the room to another changes the direction of the air currents in the room, and creates eddies and whirls which disturb the vane for a time. If the body is placed behind the vane, or close beside it, it neutralises or reverses the influence of the heat ray from the lamp, and stops rotation. So the further away the observer places himself the better for the experiment.

The motion of the air toward the body can be shown by two vanes partially screened from the body, and wholly from each other, as in fig. 7. The outer fans of each vane will advance toward the observer, and the two vanes will consequently rotate in different directions under the influence of cold air advancing towards the body. It is curious that the first movement of the vanes in presence of a ray of heat indicates repulsion.

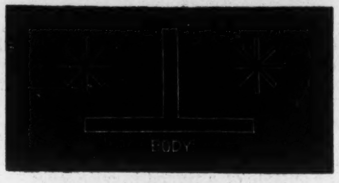

FIG. 7.

It occurred to the author that a complete circle of light material should show the currents as well as a vane, and on making a cap of tissue paper and balancing it on a needle point, it proved to be so. The cap is, under some circumstances, more delicate than the vane, and more sensitive to heat than the most sensitive Crookes's radiometer that could be procured. It was found that when a vane or a light paper cap was placed within a circular screen not quite closed (fig. 8), a ray of heat suffered to fall on the screen near the opening would set up air currents and rotation of the vane or cap, which would continue as long as the heat was applied. The direction of rotation depends on the form of the aperture in the screen. When opened out, as in A, fig. 8, so that the heat indicated by the dotted arrows falls partially within the screen, the vane or cap is repelled from the source of heat; when, as in B, the ray falls on the back of the opening, it is attracted. The direction of rotation may thus by changed by adding to the screen; when, as in B, the vane is being attracted, the placing of a book or other object, as in E, immediately causes it to stop and reverse.

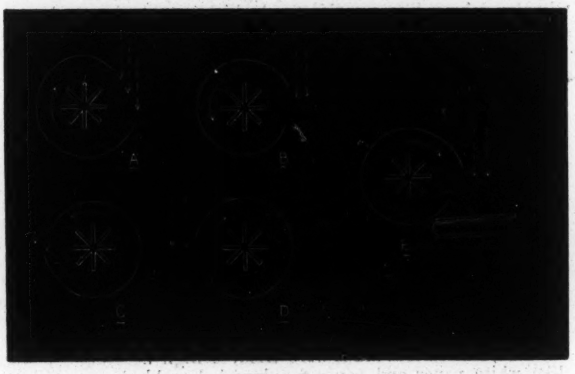

FIG. 8.

This arrangement is of extreme sensitiveness. If the observer keeps well away, rotation will continue after sunset and under a cloudy sky, when the opening of the screen is exposed to the window. It excels in this respect a Crookes's radiometer of ordinary make, which on several occasions was noticed to give up work before the screened paper cap. Simultaneous rotation of two vanes or caps in the same (fig. 9) or in different (fig. 10) directions may be secured with one screen.

FIG. 9. FIG. 11.

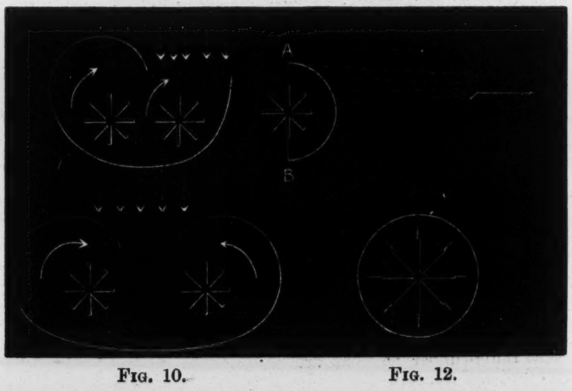

FIG. 10. FIG. 12.

The movements of neighbouring bodies are not of so much importance as with unscreened vanes, as except in the direction of the opening exterior influences, unless very violent, are intercepted. Placing the body across or near the opening disturbs, and will even stop, rotation.

Rotation may be set up by applying heat to the exterior of the screen. Thus, a ray of heat falling at A or B (fig. 11) causes rotation.

Vanes or paper caps, protected from the outer air by glass clock-shades, will rotate under sunshine or other source of heat, direction being determined by position in respect to wall of shade.

Rotation is produced by placing a heated screen round a vane. Thus, if a tinned-iron screen be taken and heated, either uniformly or at one or more points, it will when placed over a vane immediately set up rotation which will continue, even in the dark, until the screen has cooled to the temperature of the air.

Similarly, a vane inside a screen of good conducting material, as metal, will rotate when heat is applied to one point of the exterior of the screen. This can be shown by applying the tip of a hot poker to the outside of a tinned iron screen.

Although rotation occurs best in screens having an opening to the outer air, it will take place when no such opening occurs, as in fig. 12. Thus, a vane inside a metal cylinder will oscillate and then rotate when heat is applied to the exterior of the cylinder. With thin metal, the application of the finger to the metal is sufficient to impart motion.

These motions are probably due to the same cause as that of the unscreened fan (fig. 6). The screen radiates the heat it receives from the impinging ray; the air next the screen is warmed and made to ascend, and is replaced by colder air advancing on all horizontal planes. The course of the currents is determined by the form of the recess enclosed by the screen; when the form is circular or snail-like, a well-defined whirl or eddy is established, and so continuous rotation is imparted to the vane or cap. The movements caused by a screen heated before being placed round a vane, or subsequently heated at one or more points by the application of a poker to its exterior, probably have a similar origin. That the currents causing motion are horizontal seems proved by the fact that the fans of the vanes used were strictly vertical, and therefore not adapted for indicating ascending currents; and the light tissue caps supported on fine needle points would be apt to be lifted off their supports and overturned by ascending currents, whereas they rotate horizontally for hours together. Yet that ascending air plays an essential part in the phenomenon is proved by the fact that covering the top of a screen stops the motion.

A hot vane placed within a cold screen will rotate until it cools; so the condition necessary to secure rotation appears to be a difference of temperature between the air and the screen or vane.

Screens of various kinds were tried, of high absorptive power, like white paper and paper faced with lampblack, and of high reflective power, like bright tinned iron. All answer well, but the tinned iron best. With a bright snail-like screen the difficulty is not to get the vane to rotate but to stand still. Notwithstanding the vigorous motion of the vanes, exploration of the interior of the screens by suspended silk fibres does not reveal the existence of such powerful currents as might be expected.

A vane at rest will be disturbed by a new object, such as a book being placed near it, however gently the act may be performed in order to avoid creation of an actual draught. It will, after some seconds of oscillation, and perhaps a few complete turns, adjust matters with its new neighbour, and again become quiet. The placing of a similar book on the other side will renew the motion, which always follows the withdrawal or addition of an object. With a sensitive vane, alternate deflections to the right and left may be brought about by the shifting of books.

A comparison between these results and those obtained with the radiometer is inevitable. With modifications consequent on the attenuation of the air in the latter instrument, the action in both tending to the establishment of currents of defined direction, is probably identical.

The discharge from an influence machine, directed across the openings in the screens, will cause rotation of vanes, or caps within them, as will the establishment of draught, however created.

For the instrument consisting of a vane, cap, or sphere, within a screen, the author proposes the name of radioscope.

After experimenting with vanes and caps, it was determined to try spheres.

Some India-rubber balloons were distended and hung by fine silk threads, such as are used for suspending the needles of astatic galvanometers.

All the effects produced by the vanes and caps were observed, modified by the winding up of the thread consequent on rotation, and some curious ones in addition.

A balloon was found to invariably turn one particular face to the observer on being approached, and this face it would keep toward him wherever he moved, so that he could cause it to rotate by walking slowly round it. A lamp, kettle, or other source of heat, carried round, had the same effect. Observation showed that India-rubber balloons are never truly spherical when distended, and that one side is always a little lighter than the other, and that it was the light side that always turned to the heat. The effect may de accentuated by gumming a piece of paper or foil on one side, so making it heavier. No effort on the part of the observer can induce the paper or foil to face him. Wherever he goes it immediately retreats as far from him as it can.

If a fairly spherical balloon is surrounded by a zone of paper, hung on a fine fibre, and allowed to attain a state of rest, it will, when subjected to heat, begin to swing to and fro, towards and from the heat, and then to rotate slowly. (Fig. 13).

This effect is increased if the zone of paper is wetted, or one of wet linen used.

Generally, a few seconds after turning on the heat rotation begins, continues for a few seconds only, ceases, and then reverses. The rotation in the second direction is much better sustained, and will continue until the force acting is counter-balanced by the winding up of the fibre.

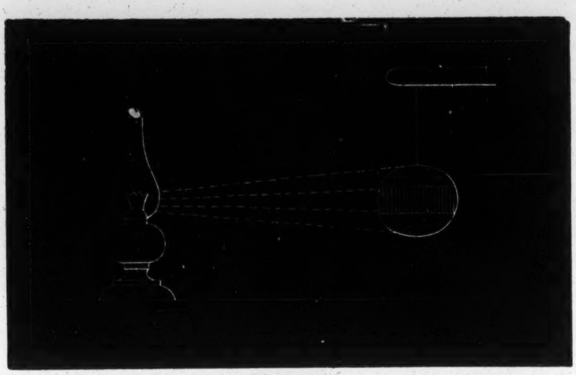

FIG. 13.

It being evident that evaporation exercised a powerful influence on the action, and the manipulation of wet paper belts being inconvenient, about half an ounce of water was put into a balloon before it was blown out, and this yielded a very convenient, and, at the same time, fairly sensitive instrument.

After shaking the water about so as to well wet the interior of the balloon, it was hung on a single silk fibre and left in the dark to come to rest, which having done, a lamp was caused to shine on it from a distance of 3 feet. After swinging a bit it turned some half a revolution to the left, stopped, and then began to rotate to the right, that is to say, in the reverse direction to the hands of a watch. After a few complete turns it paused, then continued for several turns more, sometimes pausing and going on without a reversal; sometimes reversing a little, and then continuing. When it finally stopped, the lamp was withdrawn a couple of feet, and renewed rotation was the result. Another stoppage soon occurred. The lamp was then withdrawn altogether, and rotation recommenced and continued for several more turns. The experiment was repeated many times with slightly varying, but substantially the same results. The best results were, however, attained with balloons belted with foil, and by keeping the lamp 3 feet off. When closer, rotation was not so long continued.

Suspending the balloon in a packing case, so that it is surrounded on three sides by wood, increases the uniformity of the results, although they occur markedly when suspended unscreened in a room.

The rotation produced appears to the author to be identical with that of the vanes and caps. Although the particles of bodies and gases, air included, expand when heated, indicating repulsion, yet heated bodies have a tendency to motion towards each other through the rarefication of the air between them and the presence of the heavier air behind, and motion will occur if the friction or other restraining forces are not too great. A heated body has similarly a tendency to move towards any other between which and itself its radiation rarefies the air. In the case under consideration a cone of heat from the lamp falls on the balloon, and is radiated, rarefying the air between them, and causing the balloon to slightly approach the lamp. The perpetual endeavour which follows to adjust between this horizontal force and the vertical one due to gravity may cause the balloon to rotate, although air currents due to heat radiated from the balloon probably help. A difference of temperature between the different parts of the balloon is obviously necessary. All the results point to this stoppage and reversal after the lamp has been shining some time, and subsequent continuance. The stops and reversals give the balloon time to cool by radiating to the walls of the packing case and other surrounding objects. When equally heated all round there is no tendency to deflection and no rotation.

The resumption of motion after the withdrawal of the lamp may perhaps be explained in the same way, the heated balloon now replacing the lamp as the source of heat, and acting with the walls of the room or of the packing case. When cooled by radiation to the same temperature as surrounding objects it comes to rest.

The correspondence between the effects produced by the charging up of the vane of the radiometer and its subsequent discharge, and the heating up and subsequent cooling of the balloon is noteworthy. In each case motion is produced by the charging process, until the limit of capacity is reached, and after a dead period, corresponding to the full condition, is resumed during the discharge or cooling.

This class of experiment, to ensure success, requires the observance of stringent conditions. The room should be dark, its fireplace closed, and every other precaution taken to exclude draught. At most, two observers should be present, and they should keep as far from the balloon as possible and remain still.

The suspending fibre should be single, as deceptive rotation may be got by the untwisting of a double thread; and the balloon must be hung up and left in the dark to come to rest before having the heat turned upon it. The lamp used should be the sole illuminant in the room. For these reasons I have not attempted to reproduce the experiments in a hall like this. A balloon as truly round as possible should be used—a flat side will not pass the lamp, but oscillates alternately to the left and right before it.

The direction of rotation appears capricious, although extremely well marked and persistent when once started. Possibly it is determined by the suspending fibre retaining some directive force, but the matter has yet to be properly investigated.

By far the greater number of experiments gave rotation in the reverse direction to the motion of the hands of a watch. Sunlight suffered to fall on the balloon through an opening may be substituted for the lamp. A kettle of hot water, or even the close approach of the hand or the body to a balloon suspended by a single cocoon fibre will start rotation. Between each experment the balloon should be lifted off and the fibre allowed to untwist. The violence with which it does this after prolonged rotation shows that the work done by the force, whatever it may be, is by no means inconsiderable.

The resemblance of the rotation of a balloon under the influence of heat applied to part of its circumference to that of the earth is certainly striking, although it may seem far-fetched to compare the world with an inflated windbag. Like the balloon, the earth receives heat on one side, and radiates it on the other, and evaporation (when the wet zone is used), combined with expansion of air, occurs in both cases. It is true the balloon has its atmosphere inside its shell, but the shell is elastic and capable of distortion in the direction of the heat, a distortion which may possibly have something to do with the motion.

The author regrets that, owing to the putting forward of the date of the meeting of the Institution in Edinburgh by a couple of months, the experiments are not so complete, nor the explanations so exhaustive and satisfactory as he should have liked them to have been.

APPENDIX.

Notes on Rotation of Spheres.

India-rubber balloon	simply distended	Will deflect and oscillate but not rotate.
Do.	covered with film of water	Will rotate until film has evaporated.
Do.	with zone of dry paper	Will rotate slowly and intermittently.
Do.	with zone of lamp-blacked paper	Will rotate slowly and intermittently; motion excessively slow.
Do.	with zone of wet paper or wet linen	Rotation much quicker, freer, and longer sustained. Many trials gave average speed as one turn in 1·25 minutes. Between the two stages of heating and cooling, motion in the same direction will continue for an hour.
Do.	with ½ oz. of water inside	Rotation not so free as foregoing, but arrangement more convenient.
Do.	with zone of tinfoil	This gave the best results. In some cases rotation in the same direction continued between heating and cooling for over three hours, the number of turns being from 150 to 160.

With some of the arrangements, notably, the wet paper zone, a lamp is unnecessary. If the balloon is suspended breast high, the careful approach of the body so as not quite to touch will induce rotation. Balloons of French make, which may be purchased at most India-rubber shops, are best, as they are lighter and far more symmetrical than English or American.

NEW PATENTS—1890.

11402. "Improvements in couplings for electric railway vehicles." L. Pfingst. Dated July 21. (*Complete.*)

11440. "Electric railways." F. Mansfield. Dated July 22. (*Complete.*)

11465. "Improvements relating to riveting by the aid of electricity." M. W. Dewey. Dated July 22. (*Complete.*)

11466. "An improved electro-magnetic friction clutch." T. M. Foote. Dated July 22. (*Complete.*)

11480. "Improvements in dynamo-electric machines and electro-motors." E. Thomson. Dated July 22. (*Complete.*)

11499. "Improvements in dynamo-electric machines." A. E. Wadley. Dated July 23.

11601. "A process for obtaining metals in molten condition from their fused oxides by electrical action." A. H. Cowles. (Communicated by F. W. Matthiessen, United States.) Dated July 24.

11653. "Improvements in and connected with the electric propulsion of vehicles on railways and tramways." W. E. Heys. (Communicated by J. J. Heilmann, France.) Dated July 25.

11657. "Improvements in electric dental pluggers." W. E. Gibbs. Dated July 25. (*Complete.*)

11679. "An improved electric connection." W. W. Horn. (Communicated by H. Sanche, United States.) Dated July 25.

11690. "Improvements in electro-magnetic separators for extracting metal from slag and the like." P. U. Askham and W. Wilson. Dated July 26.

11699. "Process for obtaining chlorine and bromine by the aid of electricity." G. Nahnsen. Dated July 26. (*Complete.*)

11720. "Improvements in connection with electrical fuses." R. J. Jones and G. Worrall. Dated July 26

11737. "Improvements in posts or pedestals for electric arc lamps, in the arrangement and mechanism of arc regulators, in guide apparatus for carbon holders, and in apparatus for automatically cutting an arc lamp out of circuit." F. W. Allchin and J. Lea. Dated July 26.

ABSTRACTS
OF PUBLISHED SPECIFICATIONS, 1889.

6544. "Improvements relating to electric incandescence lamps." A. A. Goldston. Dated April 16. 8d. Each of the leading in wires has a contact piece attached to it, and between the two contact pieces is arranged a cone or wedge of insulating material. To the large end of the cone or wedge is attached a metal piece which is adapted to complete the electric circuit through the contact pieces, and to the small end of the latter is attached one end of a spring, the other end of which is connected to the head of the lamp. This spring normally tends to draw the metal-piece on the cone or wedge into contact with the contact pieces, but is prevented from doing so while the carbon or light-giving conductor is intact, owing to the fact that the said carbon or conductor is sufficiently strong to prevent the leading-in wires from expanding to allow the cone or wedge to be drawn towards the contacts. Should, however, the carbon or light-giving conductor be destroyed, the cone or wedge and metal piece are moved under the action of the spring, and so make the desired contact. 5 claims.

6572. "Improvements in dynamo-electric generators and motors." G. E. Dorman. Dated April 17. 8d. A dynamo-electric generator or motor constructed according to the invention consists of two castings of iron bolted together and forming a rectangular or box-like structure, each casting being one-half of said structure and being of trough section, and interiorally and against and integral with the bottom of each casting, and centrally located, is situated a pole piece, and on the ends of each casting and integral therewith are formed ends or brackets which contain a half boss, such ends or brackets when the castings are bolted together partially or entirely enclosing the ends of said rectangular structure aforesaid, when the castings are thus bolted together the pole pieces and bosses are bored out at the same time, or at the same sitting, so as to support centrally between the pole pieces an armature. 4 claims.

6675. "Improvements in electrically-driven fans." H. G. Watel. Dated April 18. 6d. The inventor converts the rim of the fan into the armature of an electro-dynamic machine, or applies the ring armature of such a machine to the periphery of the fan, and he converts the fixed framing within or against which the fan works into field electro-magnets, or he applies such field magnets to the framing. The coils of the armature, or those of the field magnets, are connected to a suitable commutator on the axis of the fan, and thus when the machine is put in circuit with a suitable source of electricity, the fan is caused to revolve by the magnetic action applied at its periphery. 2 claims.

7856. "Improvements in electrical transformers." W. C. Johnson and S. E. Phillips. Dated May 10. 8d. The inventors construct the core of thin soft iron plates or laminae separated from each other either by being coated with a varnish containing French chalk, or by the interposition of paper, such plates being so formed as to afford angular or chamfered faces at the ends of the core. After winding upon the core so formed the primary and secondary coils, they surround them with bars similarly built up of thin plates, having a curved or angular or U-shape at the ends formed either by bending or stamping, and which have angular or chamfered faces so formed as to fit accurately against the chamfered faces of the core, the whole being thus made to present the shape of a closed loop or chain link, with a bar, constituting the core with its coils, passing across its middle, the separate plates forming the loop and core lying either parallel to the plane of the loop or at right angles thereto. 5 claims.

9166. "An improved electrical repeater and commutator, to indicate the normal position and the movements of railway or other signals, slots, and the like." D. WELLS. Dated June 3. 8d. Claim:—1. The obtaining of indications on the electrical repeater of three or more distinct and different movements of the signal arms, rods, slots, and the like; using a single-line wire, and with the battery placed in the signalman's box; by bringing a resistance coil or coils into circuit between the commutator and the "earth" connection, and providing an adjustable supplementary backweight or check in the electrical repeater to ensure accurate indications.

9241. "Improvements in electric meters." A. A. CAMPBELL SWINTON. Dated June 4. 11d. The inventor causes a suitable body to vibrate reciprocally in unison with the alternations or periods of the current, the amplitude of such vibrations being proportional to the strength of the said current, and he causes the vibrations of the body to actuate a suitable recording or counting apparatus in such a manner that the said counting apparatus is moved forward at each vibration through a space proportional to the amplitude of the vibration, and consequently to the strength of the current, so that, the periodicity being constant, the counting apparatus in a given time is moved through a space proportional to the total current that has passed during that time. 5 claims.

9571. "Arrangement of circuits and apparatus to be used in connection with telephonic communication." J. E. KINGSBURY. (A communication from abroad by F. R. Welles, of Antwerp.) Dated June 8. 8d. Consists in the arrangement of the circuits and apparatus, so that the annunciator drop of one subscriber is cut out of the line, and only one spring jack is used for each subscriber. 8 claims.

9917. "Improvements in switches used for electrical purposes." F. B. NICHOLSON. Dated June 17. 6d. The inventor uses a centre contact piece, turned taper, and working in suitably constructed contact pieces after the manner of a gas or water tap, and so arranged that when the centre contact piece or bar is in one position that the metallic or electric circuit is complete or in another position it is broken. 2 claims.

CHOOSING A RUBBER BELT.

By ROBERT GRIMSHAW.

THERE having been expressed a desire for a table which would show about how much rubber belt cross section there was needed to carry various horse-powers at various speeds, the following table (*India-Rubber World*) is offered as being convenient and practical for horse-powers from 10 to 100 inclusive, and for belt speeds from 2,000 to 2,750 inclusive. The belt is supposed to be fastened with single leather lacing. Doubling the lacing adds about one-eighth to the driving power, other things being equal, and of course calls for only about eight-ninths as much cross section for a given horse-power. If the joints were riveted there would be required only five-ninths as much belt for a given power.

BELT CROSS SECTIONS.

Horse-power.	Belt speeds.		Feet per minute.	
	2000	2250	2500	2750
10	·7	·62	·56	·51
15	1·0	·7	·8	·8
20	1·4	1·2	1·1	1·
25	1·7	1·6	1·4	1·3
30	2·1	1·9	1·7	1·5
35	2·4	2·2	2·	1·8
40	2·8	2·5	2·2	2·
45	3·1	2·8	2·5	2·3
50	3·5	3·1	2·8	2·5
55	3·8	3·4	3·1	2·8
60	4·2	3·7	3·4	3·1
65	4·5	4·	3 6	3·3
70	4·9	4·4	3·9	3·6
75	5·2	4·7	4·2	3·8
80	5·6	5·	4·5	4·1
85	6·	5·3	4·8	4·3
90	6·3	5·6	5·	4·6
95	6·6	5·9	5·3	4·8
100	7·	6·2	5·6	5·1

Thus, if we have to carry 50 horse-power and know that we are going to have belts running 2,250 feet per minute, we can see at once that it will take 3·1 square inches of cross-section rubber belt laced with single leather lacing, and having 180 arc of contact upon a cast iron pulley in good condition. We can make about this by having 12 inches of belt one-quarter inch thick or 15 inches of belt one-fifth inch thick; or if we know how wide we shall have to have our belt we can figure up very readily what thickness to get. Thus, if we cannot have more than a 10-inch belt we shall know very quickly that it will require 3·1 divided by 10, equal to 0·31 inch of belt thickness.

For other belt speeds than those given it will take in inverse proportion; thus, for 1,125 feet of belt speed per minute it will require double the quantity; that is, 30 inches of one-fifth inch belt, or 24 inches of one-quarter inch, and so on.

CORRESPONDENCE.

Accurate Measurement of Low Resistance.

Referring to Mr. A. Eden's article in the REVIEW of the 4th inst, we may mention in proof of the correctness and advantages of the methods described by Mr. Eden of "obtaining accurate measurements of low resistance by means of higher resistances in shunt" that for a number of years Messrs. Hartmann & Braun's rheostats and resistance bridges have been adjusted in this manner and thereby gained their high reputation for great accuracy. Their resistance sets of small resistance are all adjusted to their full value by a shunt of higher resistance inside the instrument, the main resistance being left a trifle too great and being silver soldered direct to the thick copper feeding wires. These instruments will therefore require no further shunts for the most accurate measurements.

O. Berend & Co.,
Representatives of Hartmann and Braun.

July 31*st*, 1890.

Secondary Battery Manipulation.

In your issue of August 1st, Mr. Shippey points out that packing the plates with a mixture of plaster of Paris and sawdust does not prevent evaporation of the liquid. I never supposed that it did, but I pointed out in a former letter, that evaporation is greatly retarded if a little carbonate of soda be added to the electrolyte. On my own authority I should hardly have ventured to make this assertion, but my attention was first called to the fact by Mr. Probert who, at the time was carrying out a series of very careful experiments at the General Post Office on the use of sulphate of soda in accumulators, and I believe it was found that where two identical cells were standing side by side in a room during six warm months, one containing ordinary dilute sulphuric acid and the other sulphate of soda, that it was necessary twice to fill up the cell containing the ordinary dilute acid, whereas the cell containing sulphate of soda, never required replenishing.

W. J. S. Barber-Starkey.

August 2*nd*, 1890.

Prof. Lodge on Alternative Path Experiments.

A passage in my communication which appeared in your last issue, owing to the accidental omission of a comma, might possibly, I think, convey the impression that Prof. Lodge was one of the scientific experts who gave evidence in the late case of King, Brown & Co. *v.* Anglo-American Brush Corporation. Perhaps you would kindly allow this letter to appear in your columns to correct any misapprehension to which the omission of the comma might give rise.

S. Alfred Varley.

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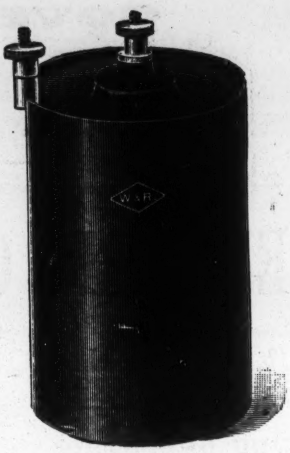

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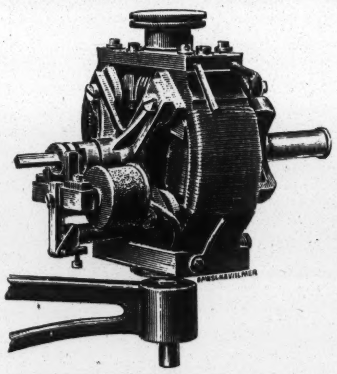

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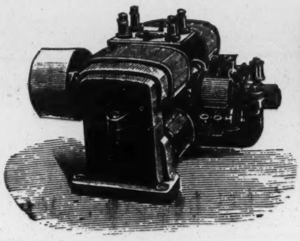

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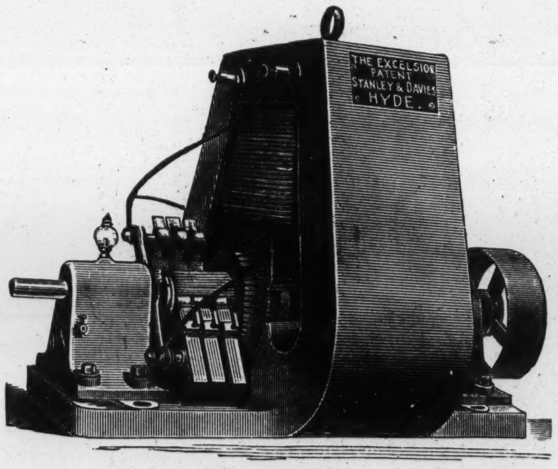
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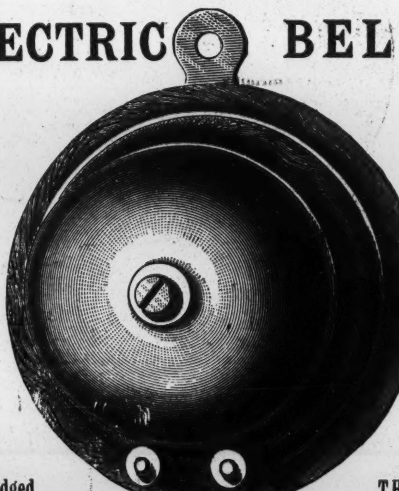

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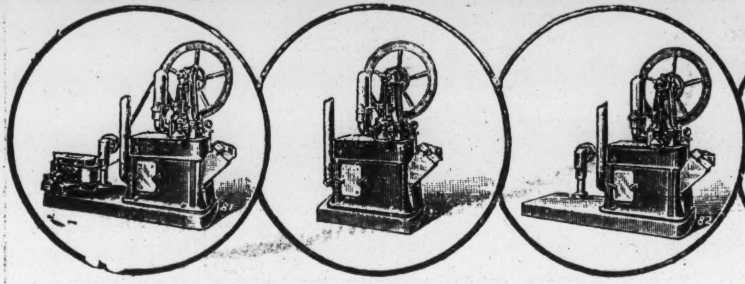

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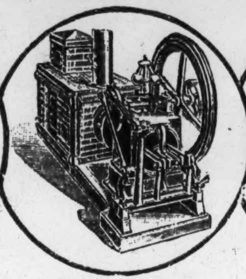

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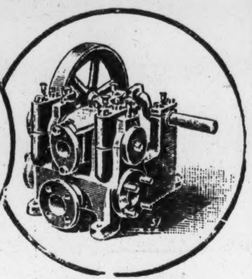

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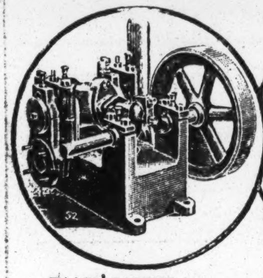

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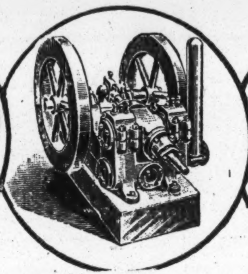

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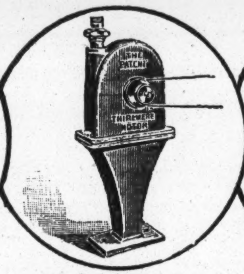

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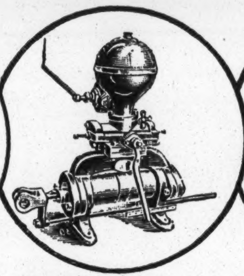

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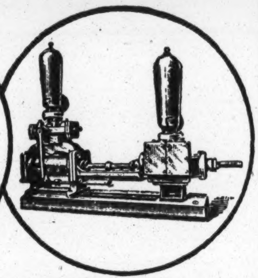

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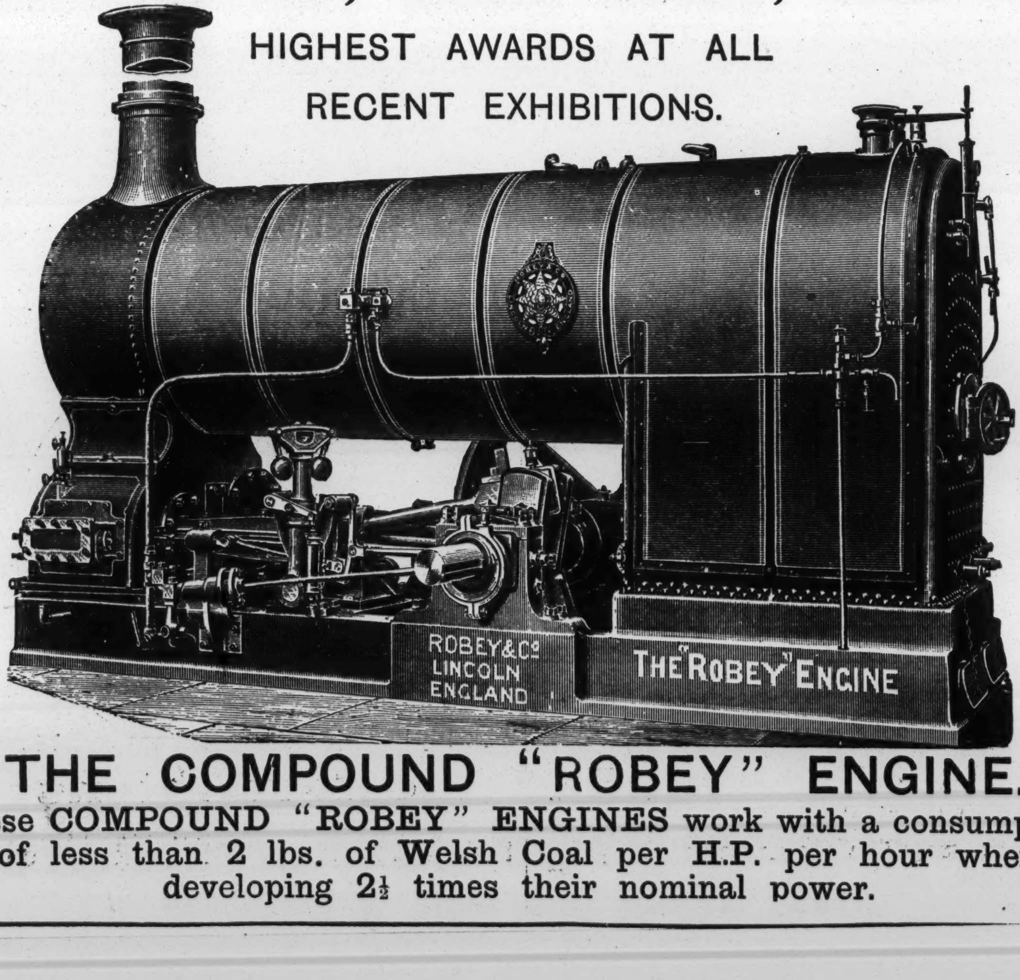

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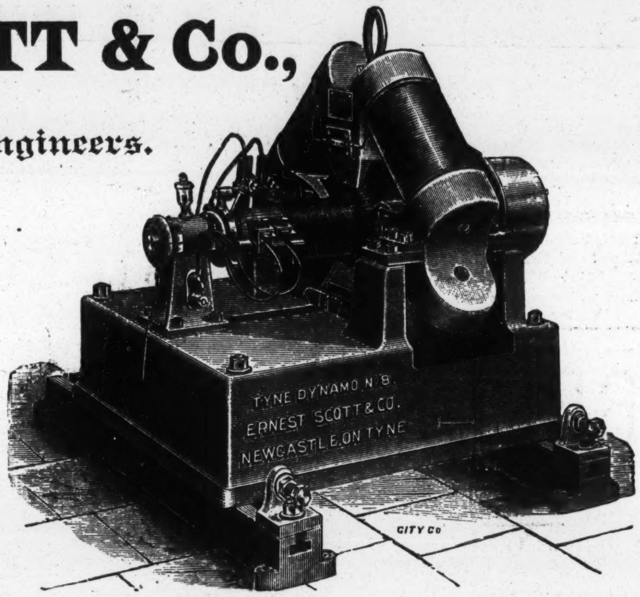

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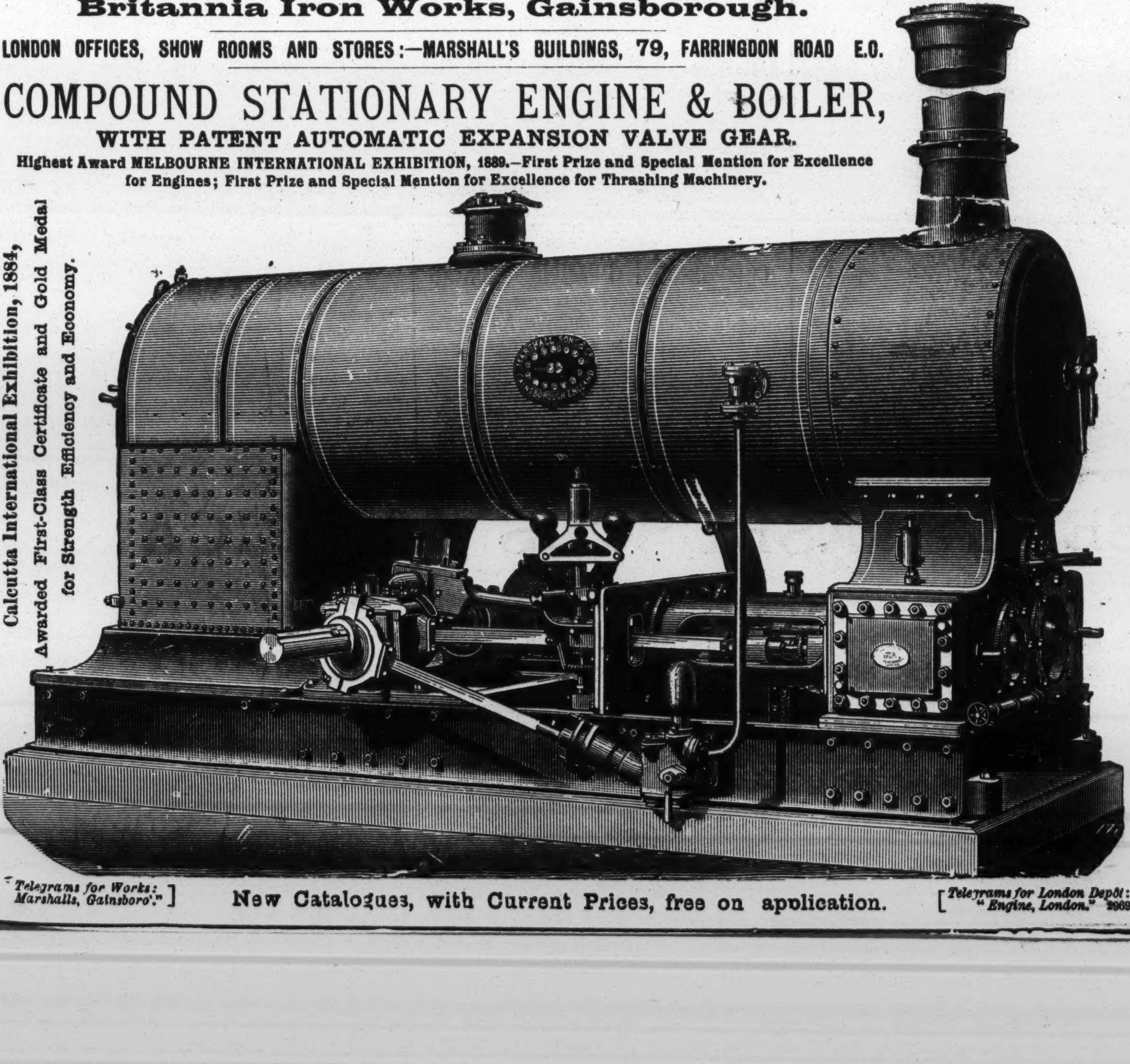

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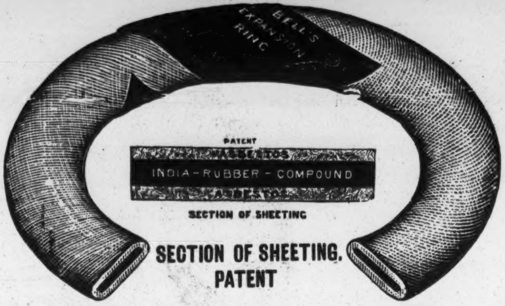

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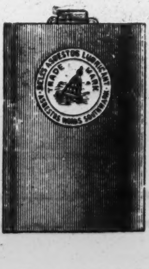

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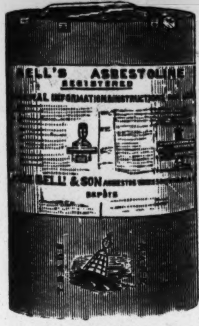

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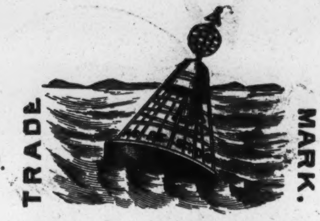

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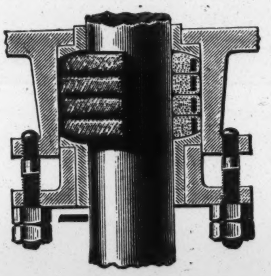

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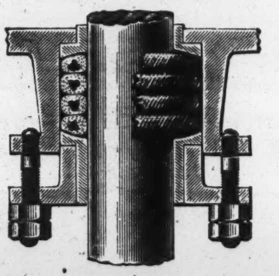

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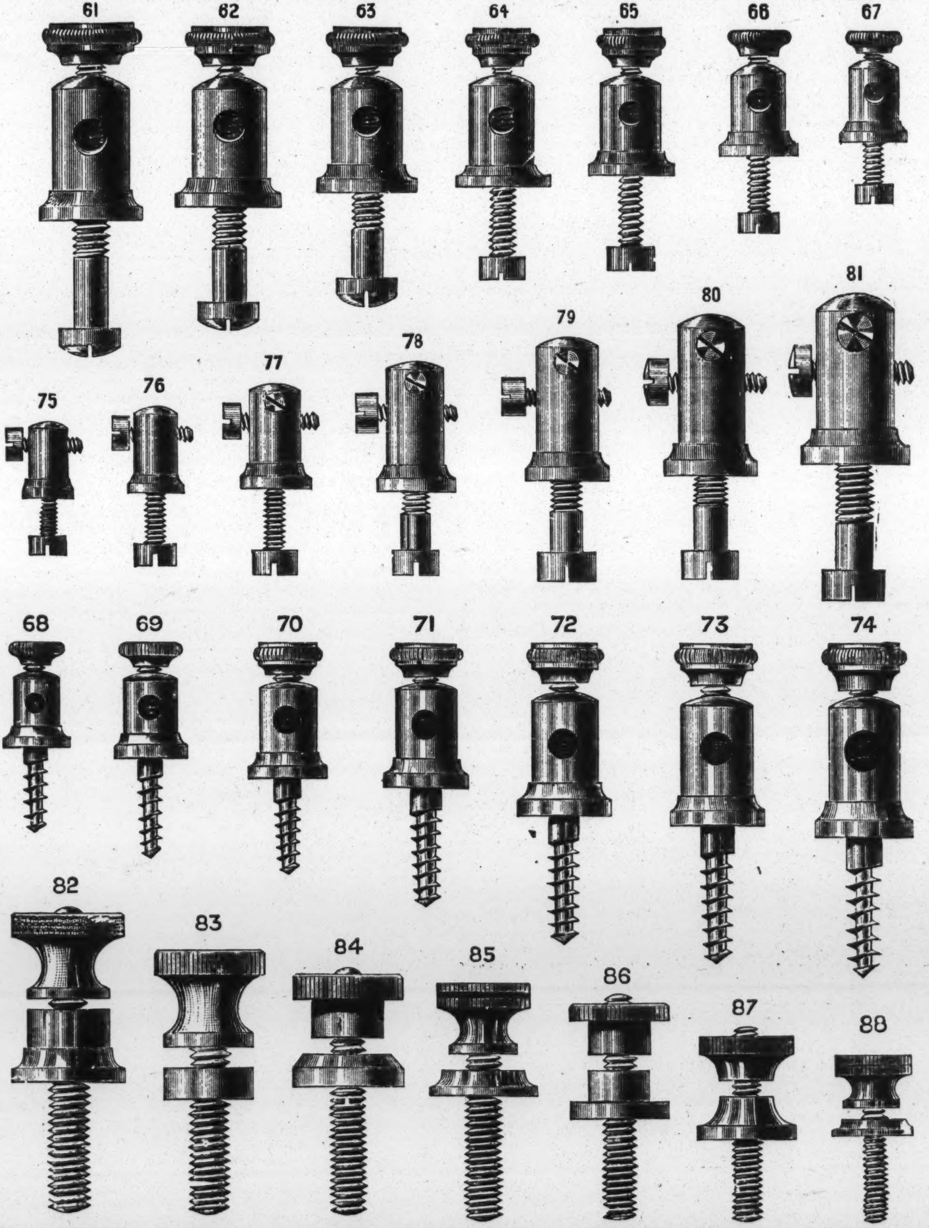

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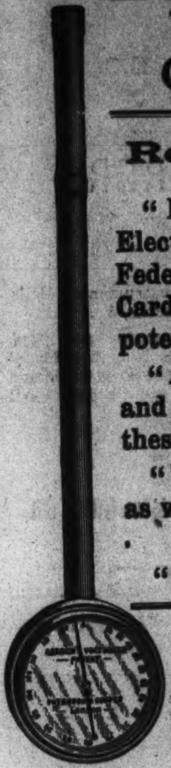

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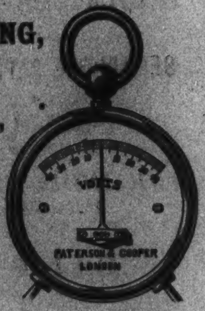

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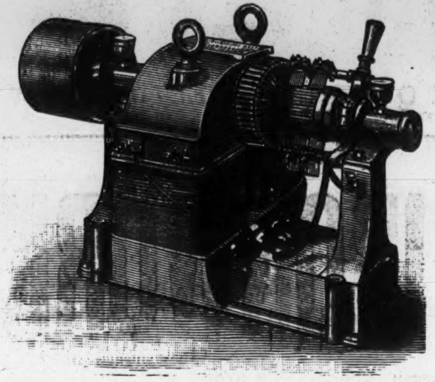

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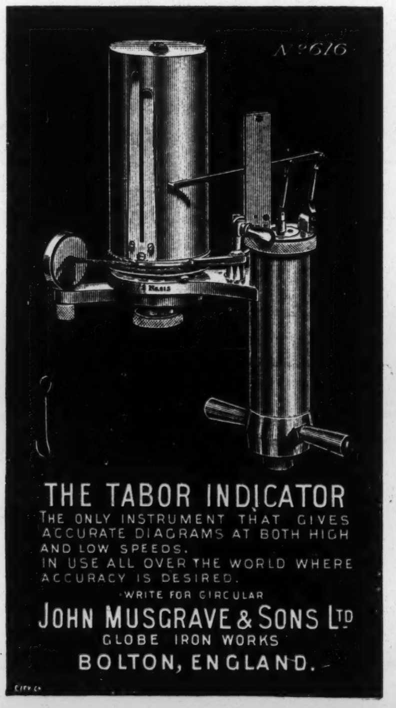

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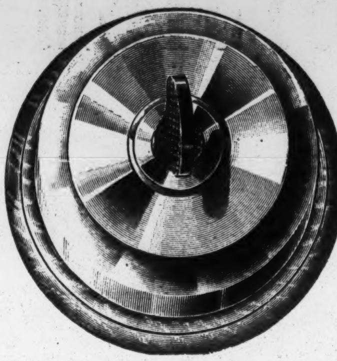

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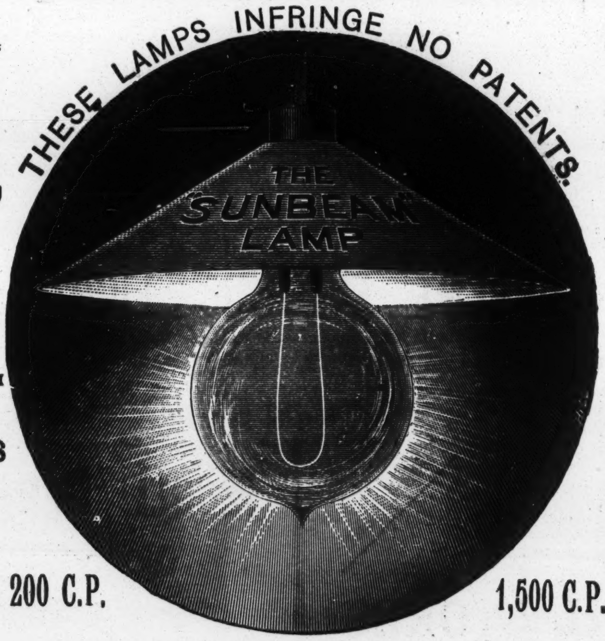
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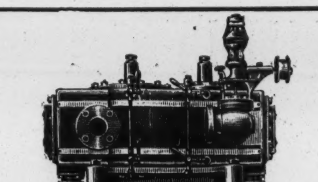

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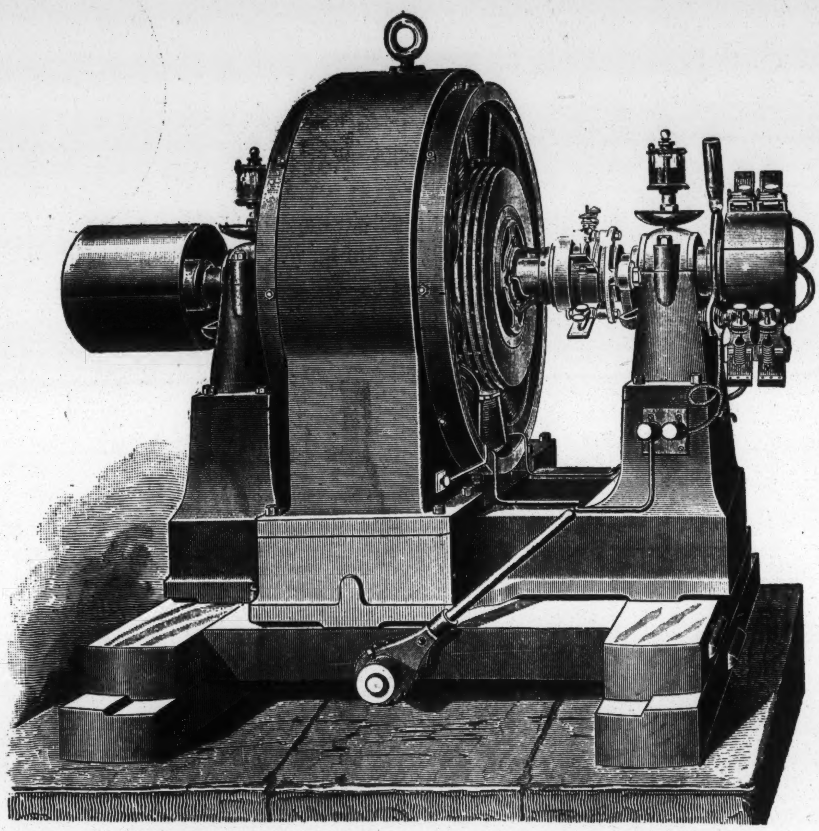

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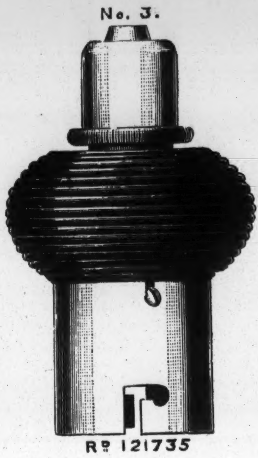

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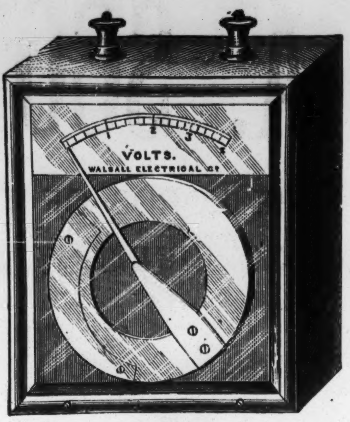

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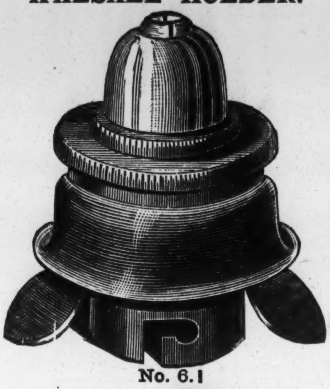

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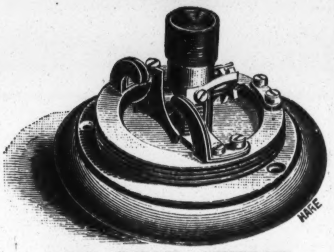

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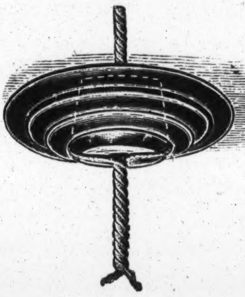
Press Once to Light the Lamp, which is Extinguished by a Second Push.



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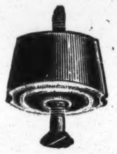

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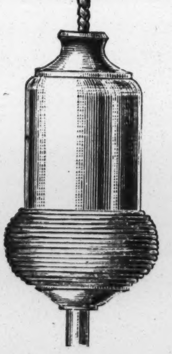

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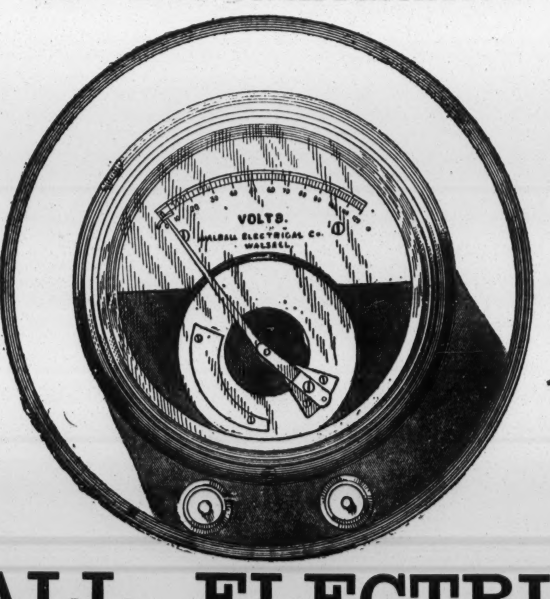

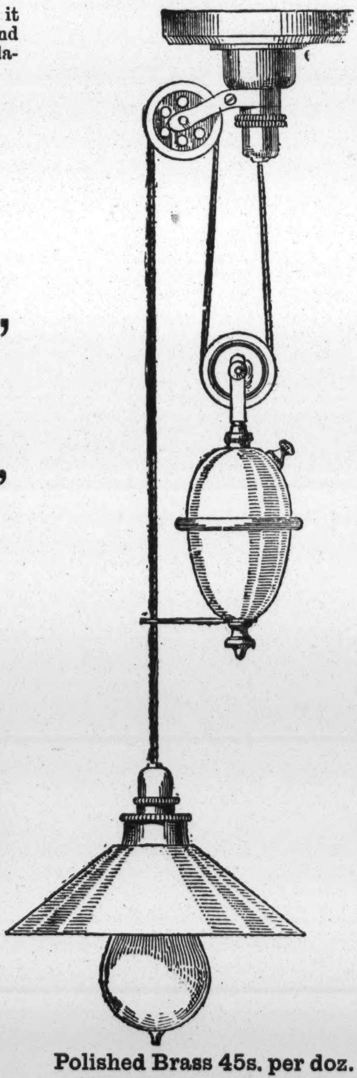

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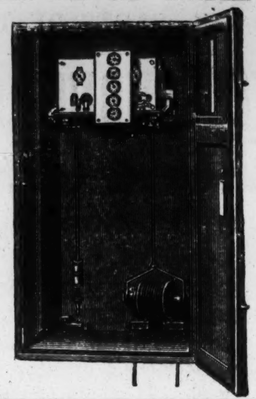

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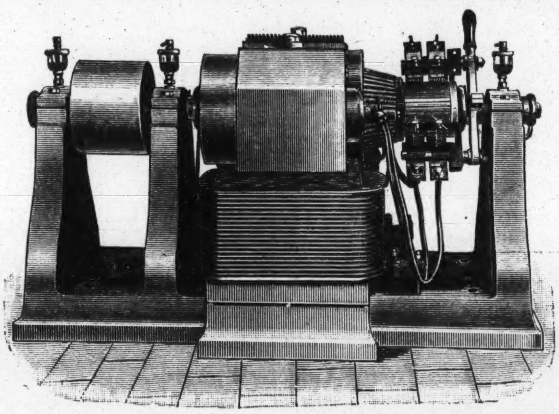

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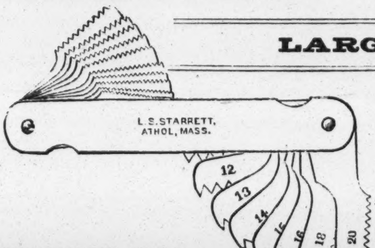

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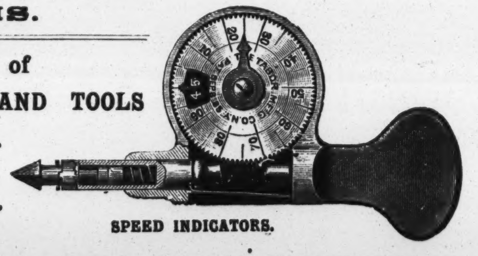

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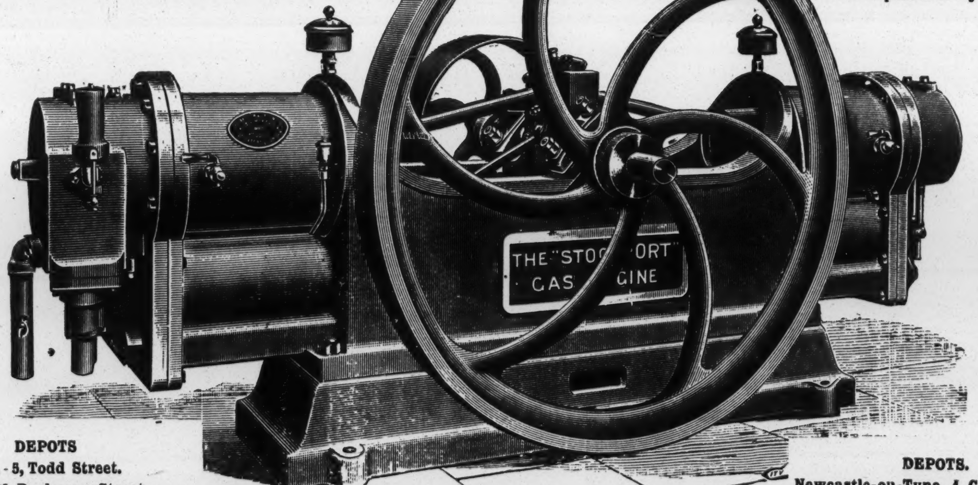

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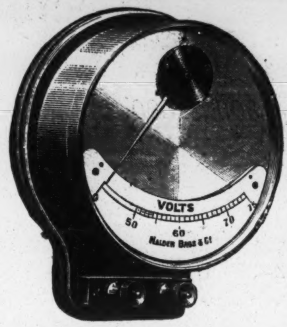

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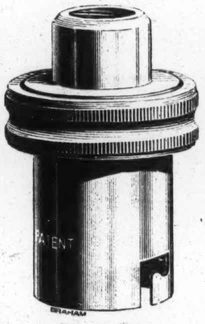

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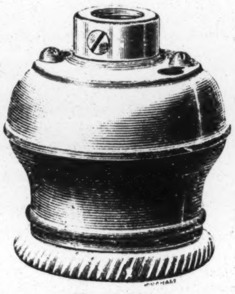

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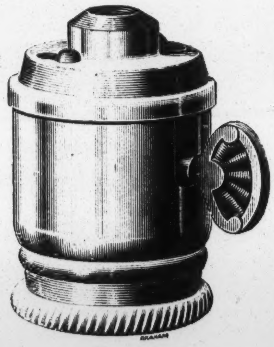

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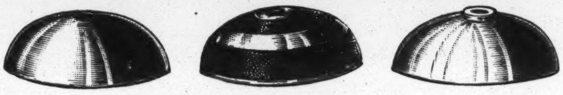

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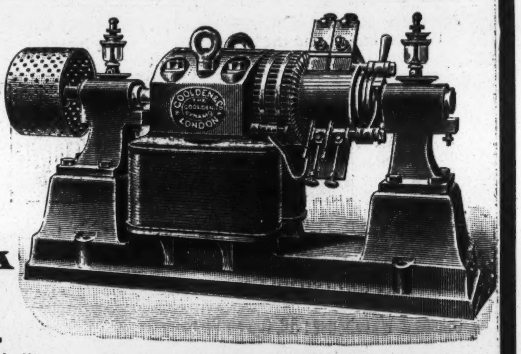

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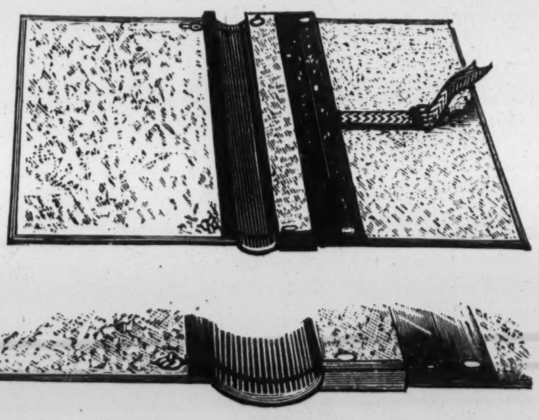

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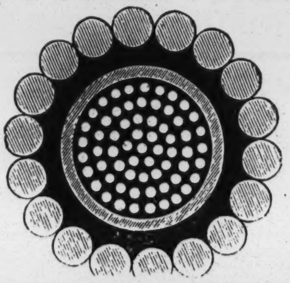

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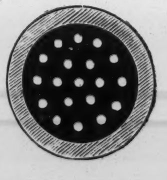

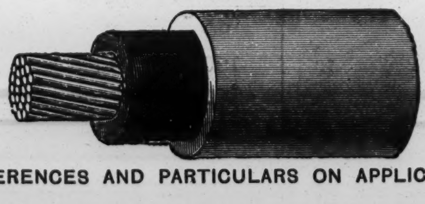

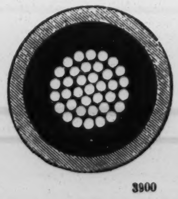

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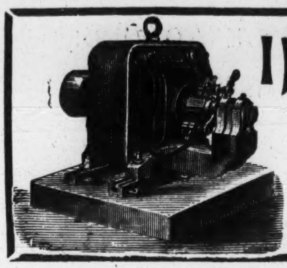

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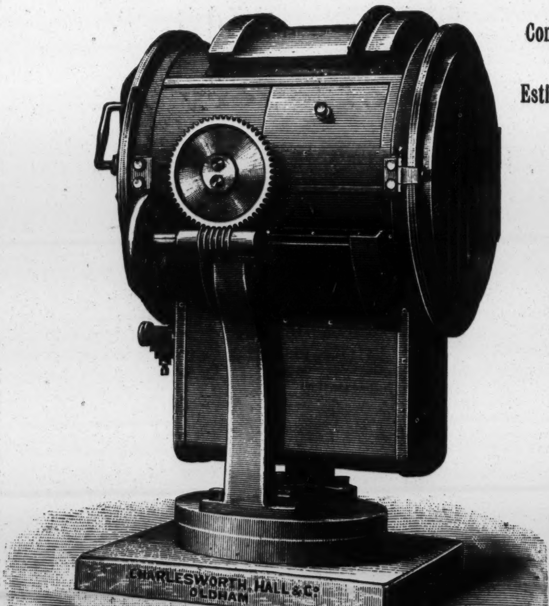

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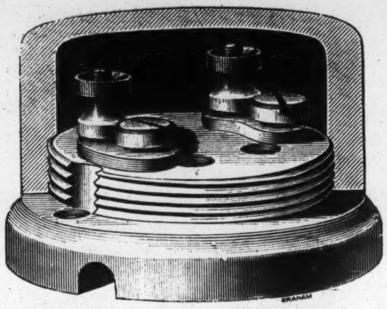

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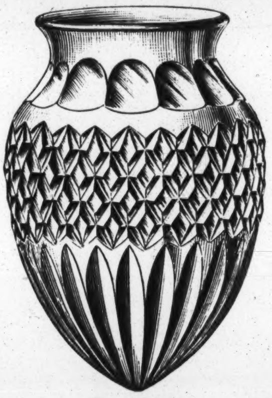

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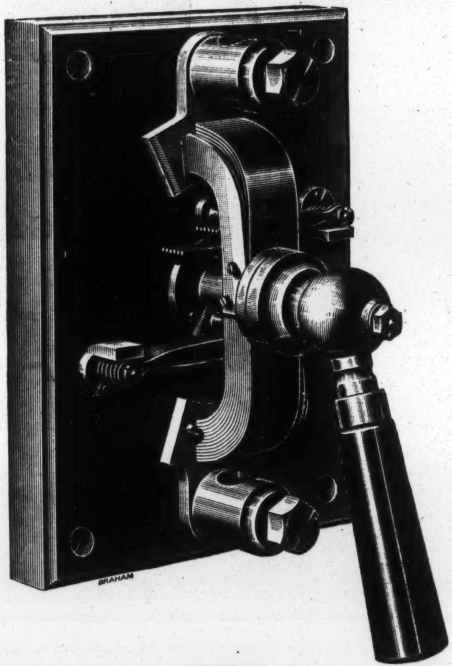

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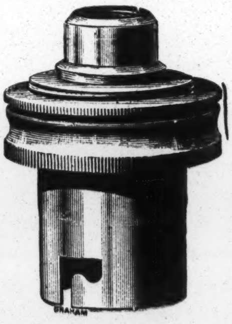

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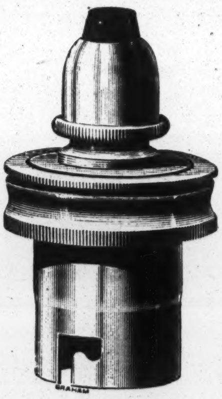

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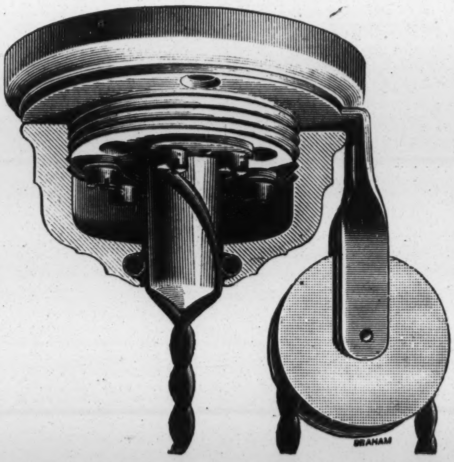

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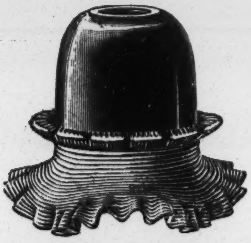

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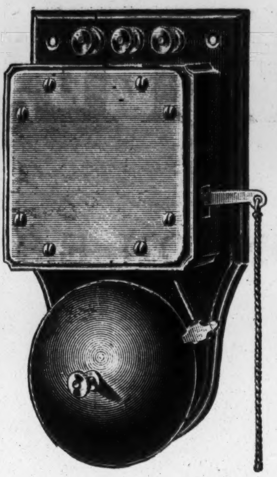

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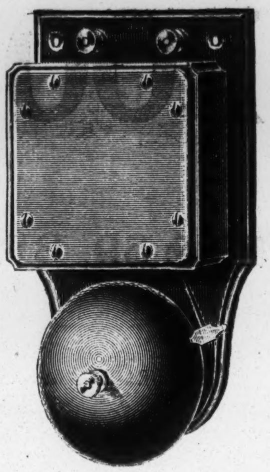

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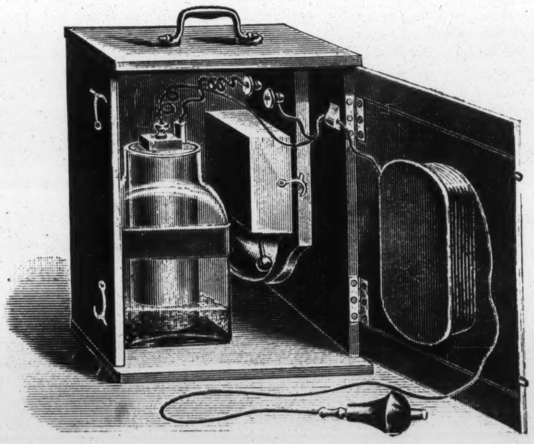

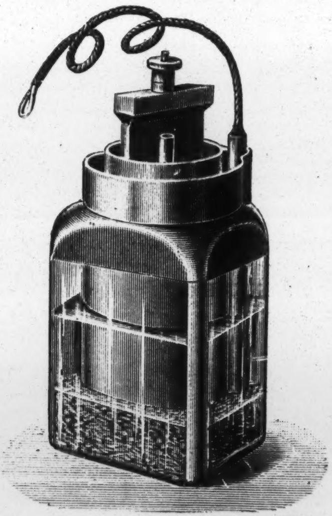

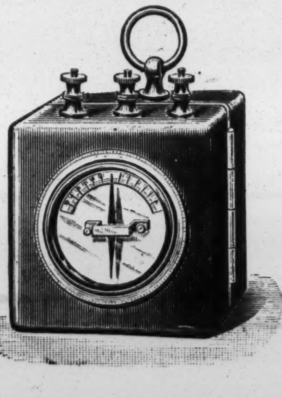

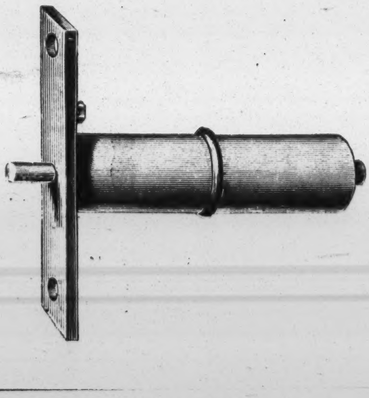

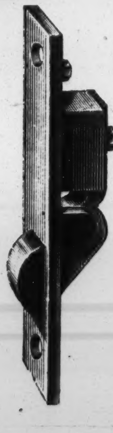

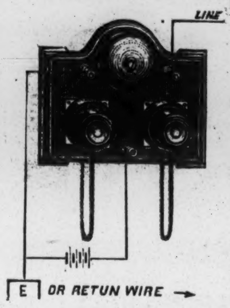

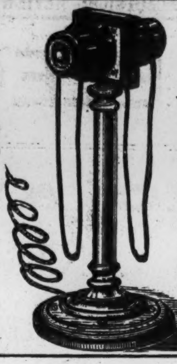

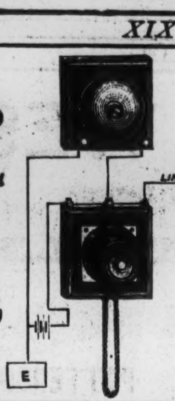

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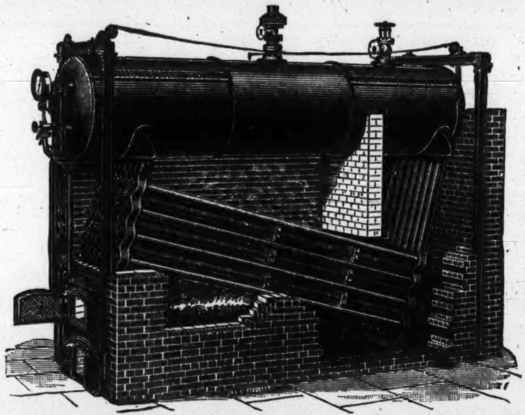

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